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# INSTALLATION RESTORATION PROGRAM

AD-A231 582

Preliminary Assessment

143rd Tactical Airlift Group  
Rhode Island Air National Guard  
Quonset State Airport  
North Kingstown, Rhode Island

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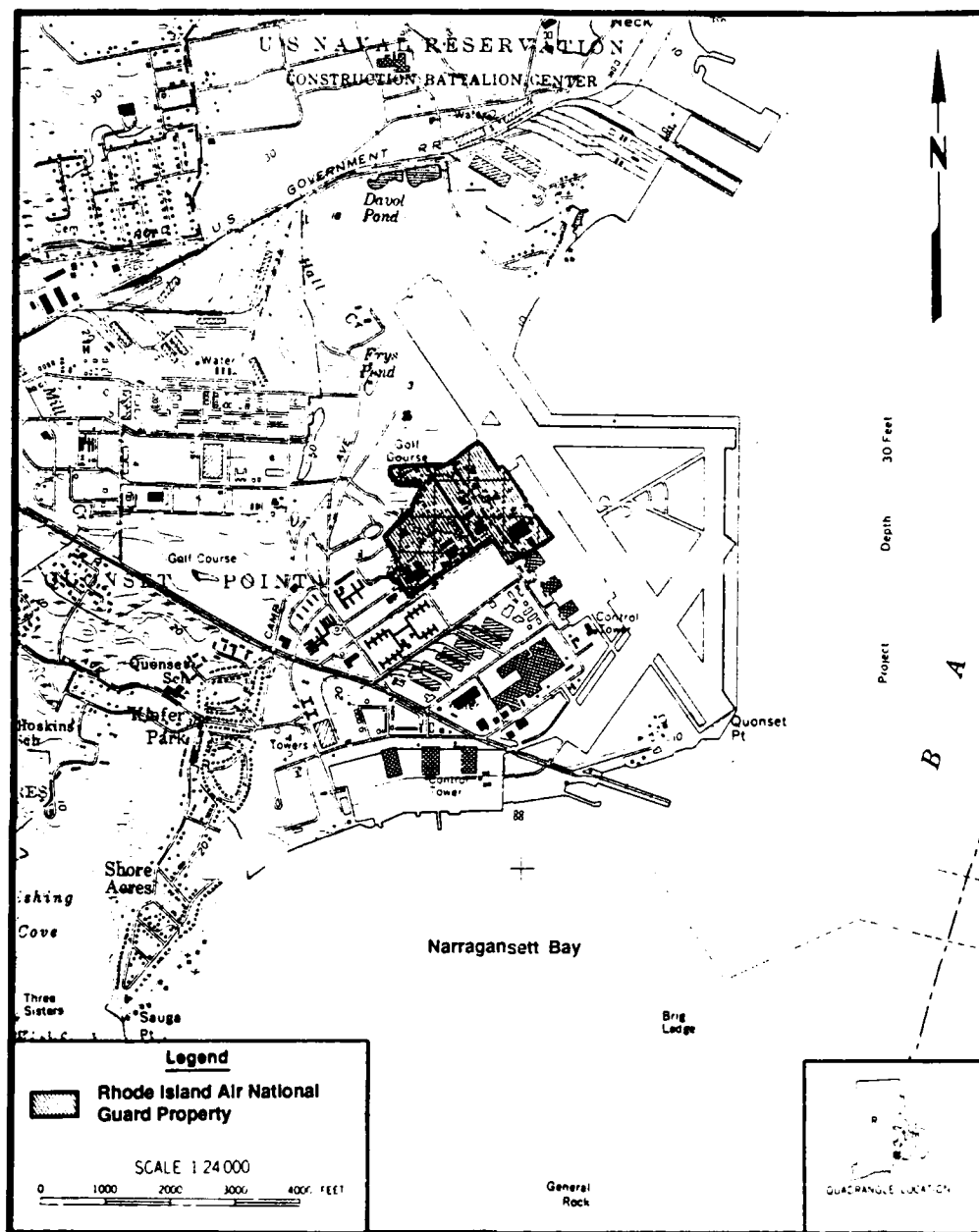
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INSTALLATION RESTORATION PROGRAM  
PRELIMINARY ASSESSMENT

FOR

143rd TACTICAL AIRLIFT GROUP  
RHODE ISLAND AIR NATIONAL GUARD  
QUONSET STATE AIRPORT  
NORTH KINGSTOWN, RHODE ISLAND

June 1990

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## ACRONYM LIST

AGE	Aerospace Ground Equipment
ANG	Air National Guard
AVGAS	Aviation Gasoline
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
FR	Federal Register
FTA	Fire Training Area
GSA	General Services Administration
HARM	Hazard Assessment Rating Methodology
HAS	Hazard Assessment Score
HM/HW	Hazardous Materials/Hazardous Wastes
HMTC	Hazardous Materials Technical Center
IRP	Installation Restoration Program
MAC	Military Airlift Command
MOGAS	Motor Gasoline
NAS	Naval Air Station
N.D.	No Date
NDI	Non-Destructive Inspection
NGB	National Guard Bureau
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OWS	Oil/Water Separator
PA	Preliminary Assessment
P.E.	Professional Engineer
P.G.	Professional Geologist
POC	Point of Contact
POL	Petroleum, Oil, and Lubricant
RD&D	Research, Development, and Demonstration
RD/RA	Remedial Design/Remedial Action
SARA	Superfund Amendments and Reauthorization Act of 1986
SI/RI/FS	Site Investigation/Remedial Investigation/Feasibility Study
TAG	Tactical Airlift Group
USAF	United States Air Force
USDA	United States Department of Agriculture
UST	Underground Storage Tank

## FOREWORD

This Preliminary Assessment (PA) document was originally prepared for the National Guard Bureau (NGB) by the Hazardous Materials Technical Center (HMTc), operated by the Dynamac Corporation. HMTc's contract for conducting PAs ended prior to completion of the final PA document. Subsequently, the NGB requested completion of this PA under an existing contract with the Hazardous Waste Remedial Actions Program (HAZWRAP) Support Contractor Office, operated by Martin Marietta Energy Systems, Inc. for the U.S. Department of Energy. In turn, HAZWRAP subcontracted with Science and Technology, Inc. for completion of the PA document. Science and Technology, Inc. successfully completed this document in June 1990.

Science and Technology, Inc. produced the final document primarily by addressing comments generated by the NGB through review of HMTc draft documents. Since HMTc conducted the PA and prepared the original PA manuscript, the content of this document is principally a reflection of HMTc's efforts.

## **EXECUTIVE SUMMARY**

### **A. Introduction**

The Hazardous Materials Technical Center (HMTc) was retained in September 1987 to conduct the Installation Restoration Program (IRP) Preliminary Assessment (PA) of the 143rd Tactical Airlift Group, Rhode Island Air National Guard, Quonset State Airport, North Kingstown, Rhode Island (hereinafter referred to as the Base), under Contract No. DLA 900-82-C-4426. The Preliminary Assessment included:

- o an on-site visit, including interviews with 25 past and present Base employees, conducted by HMTc personnel during July 5-8, 1988;
- o the acquisition and analysis of pertinent information and records on hazardous material use and hazardous waste generation and disposal at the Base;
- o the acquisition and analysis of available geologic, hydrologic, meteorologic, and environmental data from pertinent Federal, State, and local agencies; and
- o the inspection of areas on the Base that may potentially be contaminated with hazardous materials/hazardous wastes (HM/HW).

### **B. Major Findings**

Past Base operations involved the use and disposal of materials and wastes that were subsequently categorized as hazardous. The Base shops that use and dispose of HM/HW include Aircraft Maintenance, Aerospace Ground Equipment (AGE), Vehicle Maintenance, Non-Destructive Inspection (NDI), Paint Shop, Battery Shop, Photographic Laboratory, and Propulsion Shop. Waste solvents, oils, vehicle fluids, photographic chemicals, inspection chemicals, battery acid, thinners, strippers, JP-4, used batteries, and waste cans are generated by activities at these shops.

Interviews with past and present Base personnel and a field survey resulted in the identification of no disposal and/or spill sites at the Base that are potentially contaminated with HM/HW.

**C. Conclusions**

Information obtained through interviews with past and present Base personnel resulted in the identification of no areas on the Base that are potentially contaminated with HM/HW.

**D. Recommendations**

No further IRP investigation is recommended for the Base.

## **I. INTRODUCTION**

### **A. Background**

The 143rd Tactical Airlift Group (TAG) of the Rhode Island Air National Guard (hereinafter referred to as the Base), is located at Quonset State Airport, Washington County, North Kingstown, Rhode Island. The unit currently operates C-130 aircraft to provide military airlift services to the Military Airlift Command (MAC). Past operations at the Base involved the use and disposal of materials and wastes that subsequently were categorized as hazardous. Consequently, the National Guard Bureau (NGB) has implemented its Installation Restoration Program (IRP). The IRP consists of the following:

- o Preliminary Assessment (PA) - to identify past spill or disposal sites posing a potential and/or actual hazard to public health or the environment.
- o Site Investigation/Remedial Investigation/Feasibility Study (SI/RI/FS) - to acquire data via field studies for the confirmation and quantification of environmental contamination that may have an adverse impact on public health or the environment and to select a remedial action through preparation of a feasibility study.
- o Research, Development, and Demonstration (RD&D) - if needed, to develop new technology for accomplishment of remediation.
- o Remedial Design/Remedial Action (RD/RA) - to prepare designs and specifications and to implement site remedial action.

### **B. Purpose**

The purpose of this Preliminary Assessment is to identify and evaluate suspected problems associated with past hazardous waste handling procedures, disposal sites, and spill sites on the Base. Personnel from the Hazardous Materials Technical Center (HMTTC) visited the Base, reviewed existing environmental information, analyzed Base records concerning

the use and generation of hazardous materials/hazardous wastes (HM/HW), and conducted interviews with past and present Base personnel familiar with past hazardous materials management activities. A physical inspection was made of the various facilities. Relevant information collected and analyzed as a part of the Preliminary Assessment included the history of the Base; local geologic, hydrologic, and meteorologic conditions that may affect migration of contaminants; local land use; and public utilities that could affect the potential for exposure to contaminants; and the ecologic settings that indicate environmentally sensitive habitats or evidence of environmental stress.

### C. Scope

The scope of this Preliminary Assessment is limited to operations conducted by the Base and includes:

- o an on-site visit;
- o the acquisition of pertinent information and records on hazardous materials use, hazardous wastes generation, and disposal practices at the Base;
- o the acquisition of available geologic, hydrologic, meteorologic, land use, critical habitat, and utility data from various Federal, State, and local agencies;
- o a review and analysis of all information obtained; and
- o the preparation of a report to include recommendations for further actions.

The on-site visit and interviews with past and present Base personnel were conducted during the period July 5-8, 1988. The Preliminary Assessment was conducted by Ms. Natasha Brock, Task Manager/Environmental Scientist; Ms. Betsy Briggs, Hazardous Waste Specialist; and Mr. Andy Peters, Staff Scientist. Other HMTC personnel who assisted with the Preliminary Assessment include Mr. Raymond G. Clark, P.E./Department Manager and Mr. Mark Johnson, P.G./Program Manager (Appendix A). Personnel from the Air NGB who assisted in the Preliminary Assessment include Mr. Sal Orochena,

Project Officer. The Point of Contact (POC) at the Base was Lieutenant James Salem, Base Civil Engineer.

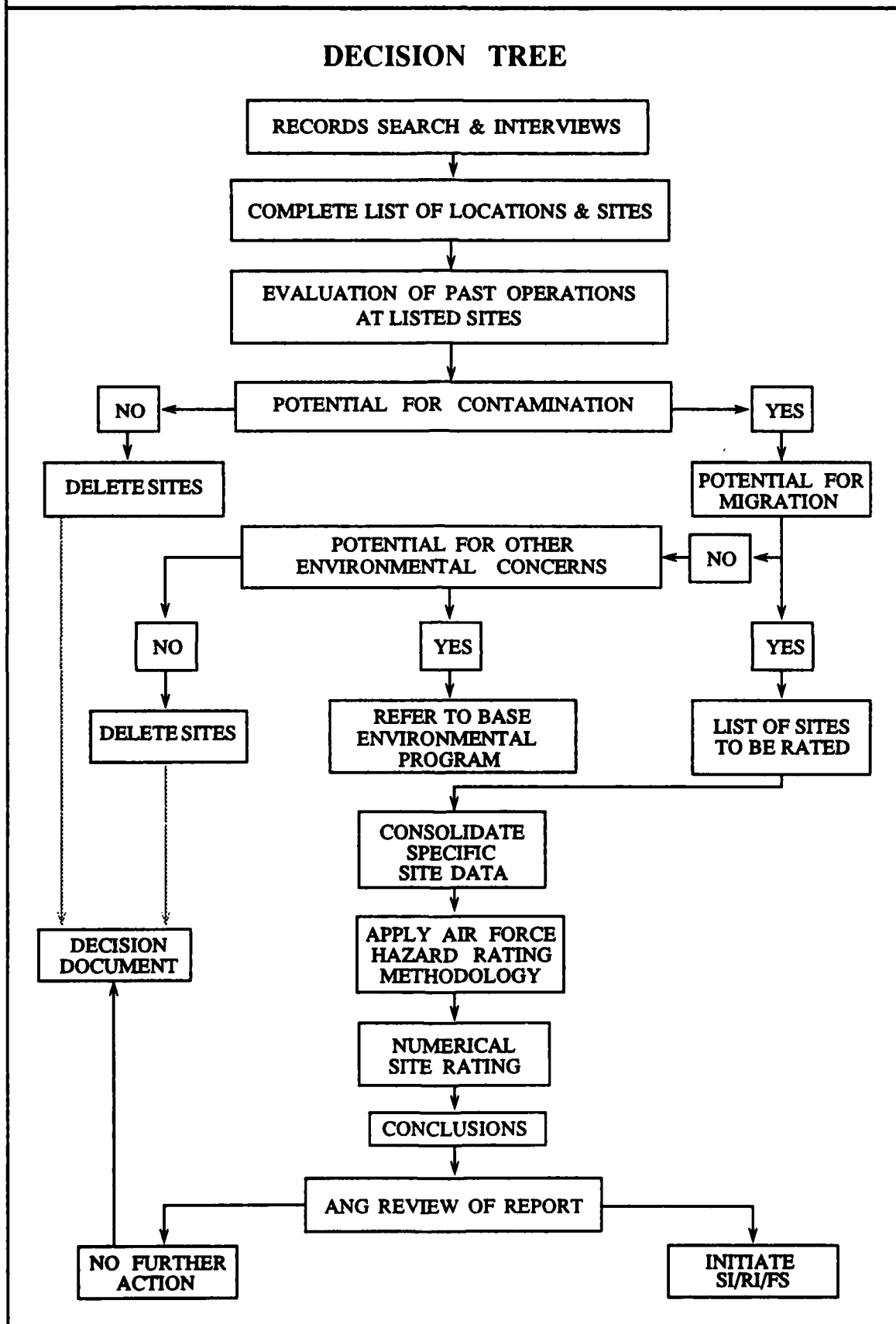
#### **D. Methodology**

A flow chart of the Preliminary Assessment Methodology is presented in Figure 1. This methodology ensures a comprehensive collection and review of pertinent, site-specific information and is used in the identification and assessment of potentially contaminated hazardous waste spill/disposal sites.

The Preliminary Assessment begins with a site visit to the Base to identify all shop operations or activities on the installation that may use hazardous materials or generate hazardous wastes. Next, an evaluation of both past and present HM/HW handling procedures is made to determine whether any environmental contamination has occurred. The evaluation of past HM/HW handling practices is facilitated by extensive interviews with past and present employees familiar with the various operating procedures at the Base. These interviews also define the areas on the Base where any HM/HW, either intentionally or inadvertently, may have been used, spilled, stored, disposed of, or otherwise released into the environment.

Historic records contained in the Base files are collected and reviewed to supplement the information obtained from interviews. Using this information, a list of past waste spill/disposal sites on the Base is developed. These sites are subject to further evaluation. A general survey tour of the identified sites, the Base, and the surrounding area is conducted to determine the presence of visible contamination and to help assess the potential for contaminant migration. Particular attention is given to locating nearby drainage ditches, surface water bodies, residences, and wells.

Detailed geologic, hydrologic, meteorologic, land use, and environmental data for the area of study is also obtained from the POC, and from appropriate Federal, State, and local agencies. A list of outside agencies contacted is in Appendix B. Following a detailed analysis of all the information obtained, areas are identified as suspect where HM/HW disposal and/or spills may have occurred. Where sufficient information is available, sites are assigned a Hazard Assessment Score



(HAS) using the United States Air Force (USAF) Hazard Assessment Rating Methodology (HARM) and Guidelines (Appendix C). However, the absence of a HAS does not necessarily negate a recommendation for further IRP investigation, but rather, may indicate a lack of data. The HAS is computed from the data included in the Factor Rating Criteria.

## **II. INSTALLATION DESCRIPTION**

### **A. Location**

The Rhode Island Air National Guard (ANG) is located at Quonset State Airport in Washington County, North Kingstown, Rhode Island. The area occupied by the 143rd TAG was once part of the Quonset Point Naval Air Station (NAS). The Station grounds are now occupied by the 143rd TAG and a construction battalion (Figure 2). The NAS was closed in 1972 and remained unused until 1980. At that time, the General Services Administration (GSA) gave the property to the port authority. In late 1978, the ANG started construction on the Base and occupied the Base in late 1980.

Many former buildings have been demolished, and the area is now an industrial park consisting of light industry and commercial businesses. The Base occupies an area next to the runways, which are situated on the shore of the Narragansett Bay.

The buildings that the unit now occupies were once the NAS Commissary (Bldg. P-1) and the Hangar (Bldg. P-13). All the other buildings are new except for Bldgs. P-1, P-4, P-9, P-12, and P-13, which were refurbished for use by the unit.

Although shown on the map, there are no current residences within a 1-mile radius of the Base. This housing was for the NAS, and has since been demolished by the County. Since there are no residences, the residential population within 1-mile of the Base is zero. The Base work force is 236. In addition, approximately 1000 people are on the Base one weekend per month for training.

### **B. History of the Base**

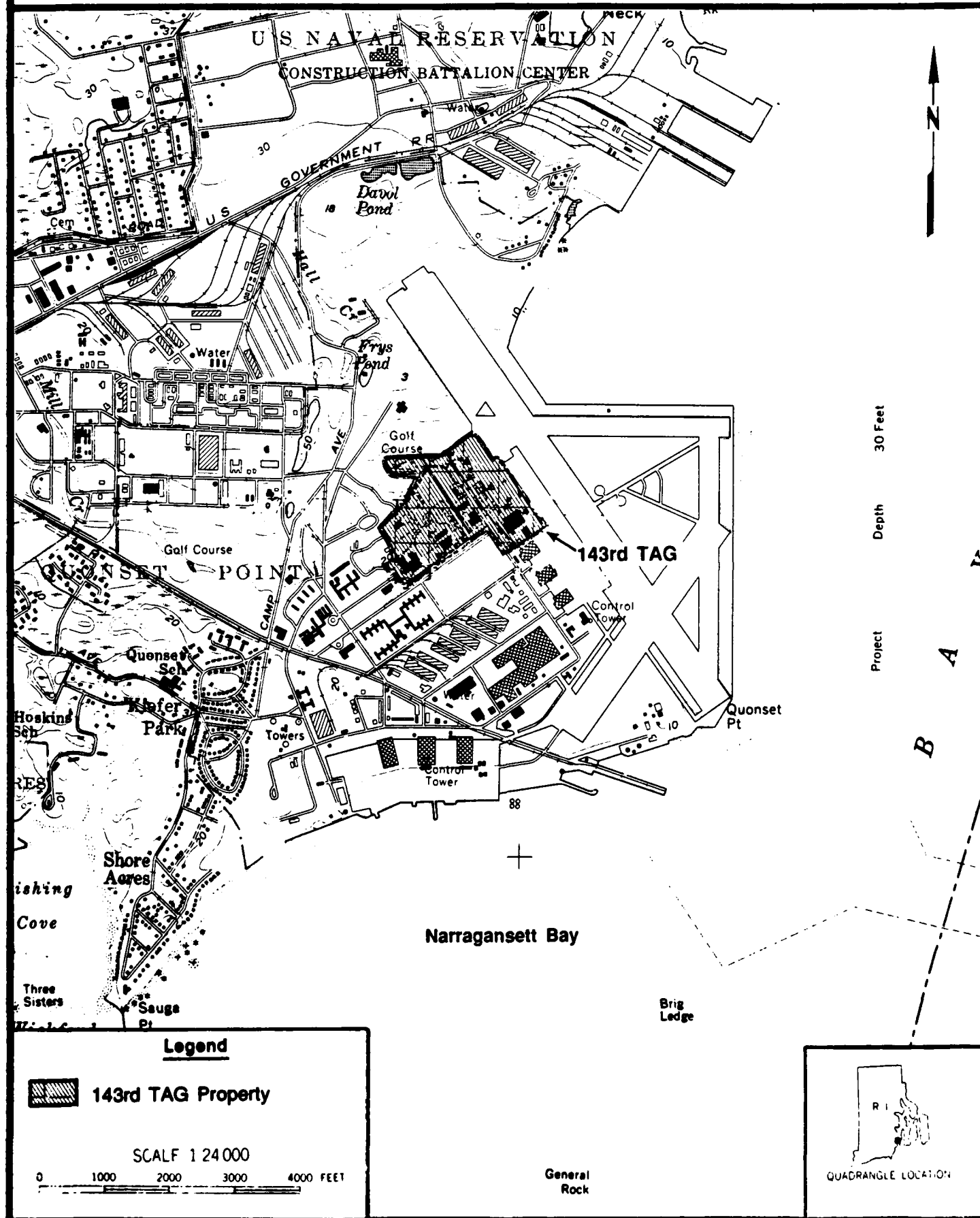
The 143rd Tactical Airlift Group (TAG), now located at Quonset State Airport, was originally located at T.F. Green Airport in Providence, Rhode Island. In 1980, the unit moved to its present location.

Figure 2.

HMTC

Source: USGS, 1975.

Location Map of the 143rd TAG, Rhode Island Air National Guard, Quonset State Airport, N. Kingstown, Rhode Island.



The 143rd TAG's mission is to provide a total capability to deploy, redeploy, and employ air and ground fighting forces and provide sustaining logistical support to those fighting forces. Military airlift squadrons furnish air logistic support between the U.S. and overseas areas on a special assignment and common user basis, provide global aeromedical evacuation, and augment tactical airlift squadrons. The 143rd TAG currently operates and maintains C-130 aircraft.

### **III. ENVIRONMENTAL SETTING**

#### **A. Meteorology**

The meteorological data in this section is local data compiled for the North Kingstown, Rhode Island area. Its source is the National Oceanic and Atmospheric Administration (NOAA).

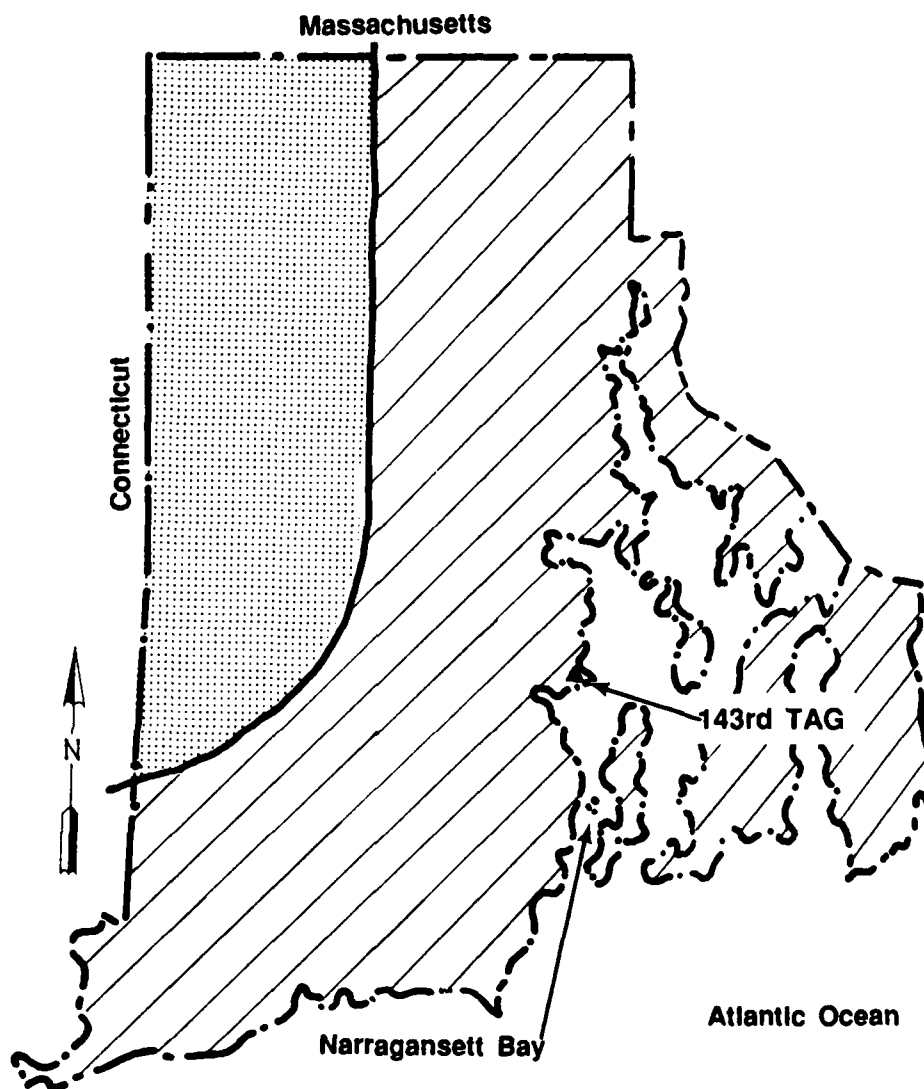
The climate of Rhode Island is cold in the winter and warm in the summer. The start and end of the warm period are influenced by the moderating effects of the Atlantic Ocean. The average winter temperature is 30°F, and the average summer temperature is 70°F.

The annual precipitation is 48 inches. A net precipitation value of 18 inches per year is obtained by subtracting the mean lake evaporation (30 inches) from the annual precipitation (48 inches). Maximum rainfall intensity, based on a 1-year, 24-hour rainfall, is 2.5 inches (United States Environmental Protection Agency, 1982).

#### **B. Geology**

Topographically, the land surface at the Base and in the area surrounding it is relatively flat. Surface elevations within a one-mile radius of the Base range from 0 to 50 feet above mean sea level (AMSL). The greatest area of relief is at the golf course approximately 400 feet north of the Base's northern boundary. Elevations at the Base range from 8 to 30 feet AMSL.

The State of Rhode Island lies within the New England Upland and the Seaboard Lowland sections of the New England Physiographic Province. The areal distribution of these sections in Rhode Island is shown in Figure 3. The Base is located in the Seaboard Lowland section. The boundary that separates these sections in Rhode Island is an escarpment with elevation changes from 400 to 600 feet AMSL. Topographically, the New England Upland is a plateau that rises above the Seaboard Lowland section. Its elevations range from 600 to 800 feet AMSL. The land surface of the New England Upland, which consists of rolling hills and stream valleys, has been



Legend

New England Upland Section 

Seaboard Lowland Section 

143rd TAG ▲

Scale in miles



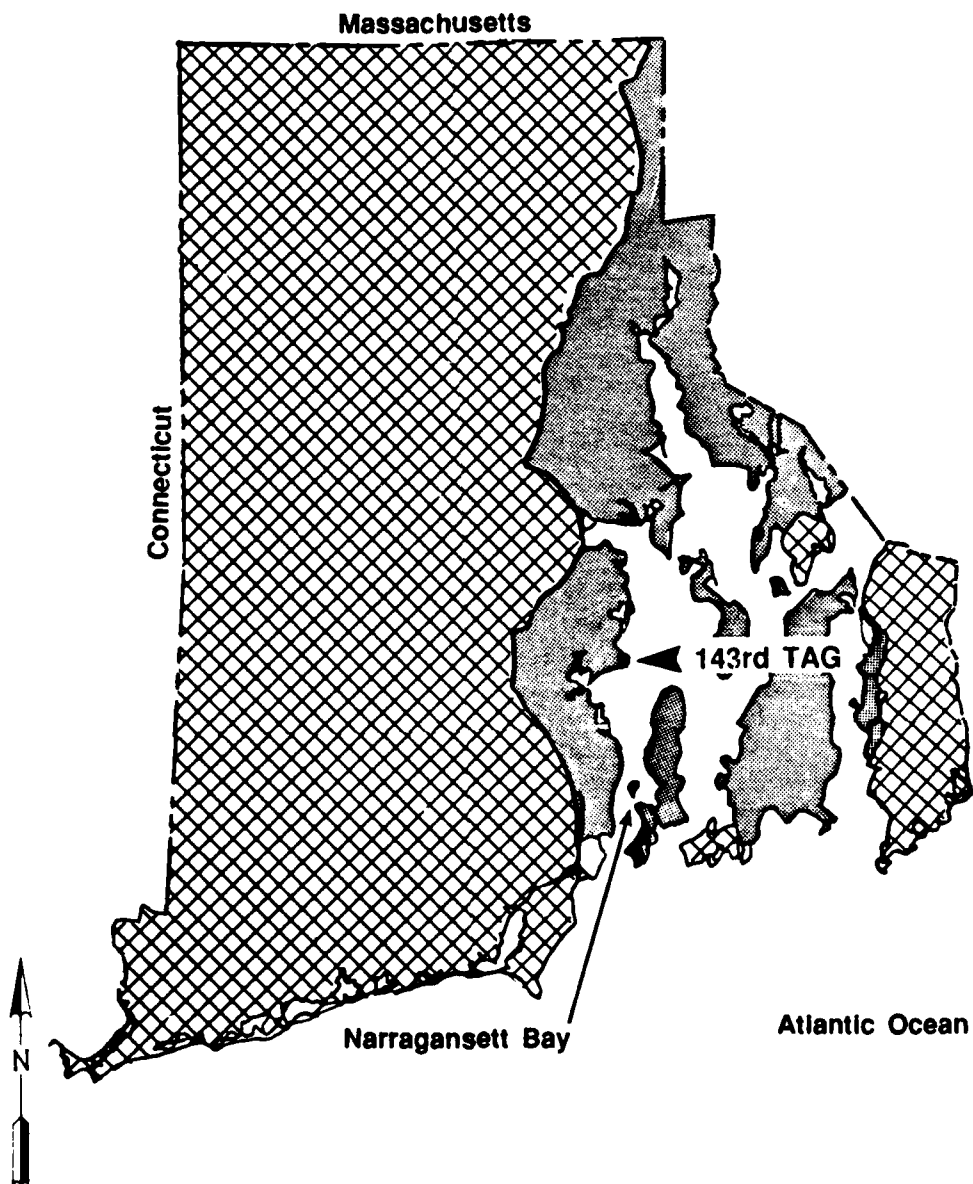
dissected by stream erosion. Also, the land surface has been modified by Pleistocene glaciation, as evidenced by rounded hills and moraine topography. The Seaboard Lowland surface consists of flat areas, gently rolling hills, swamps, and ponds. Like the New England Upland, this surface has also been modified by Pleistocene glaciation (Fenneman, 1938).

Generally, the bedrock in Rhode Island consists of igneous, metamorphic, and sedimentary rocks. With regard to character, distribution, and structure, these rocks can be divided into two major groups. The first group consists of igneous and metamorphic rocks that predate and postdate the Pennsylvanian and Mississippian Periods. The second group consists of sedimentary rocks of the Mississippian and Pennsylvanian Periods. These sedimentary rocks are limited to the Narragansett Basin, a Pennsylvanian synclinal basin that encompasses portions of Rhode Island and Massachusetts. In this basin, the bedrock is nearly 12,000 feet thick. The Base is located atop the Narragansett Basin. Figure 4 shows the areal distribution of the Narragansett Basin and the bedrock in Rhode Island.




The Base is located in the Wickford Quadrangle. The bedrock formations in this quadrangle are the Precambrian Biotite Gneiss of the Blackstone Series, the Mississippian or older Hope Valley Alaskite Gneiss and Ten Rod Granite Gneiss, and the Pennsylvanian Pondville Conglomerate and Rhode Island Formation (Williams, 1964). The stratigraphic sequence for these formations is shown on Table 1.

The Base is underlain by the Rhode Island Formation. The Rhode Island Formation is the thickest and most extensive Pennsylvanian-Aged formation within the Narragansett Basin. The formation is mapped within the Wickford Quadrangle as two separate units: (1) undifferentiated clastic facies and (2) argillaceous facies. These units were derived from previous studies by Emerson (1917) and Nichols (1956). The Base is underlain by the undifferentiated facies.

The Rhode Island Formation's undifferentiated facies consist of a thick sequence of light gray to black, partially metamorphosed sedimentary rocks including quartzose, carbonaceous, and feldspathic sandstone; arkose; sublitharenite; coarse- to fine-grained conglomerate; and shale. These rocks are characterized by sharp variations in grain size, mineralogy, and areal extent. Individual beds are discontinuous. As a result, lateral facies changes are common



**Legend**

-  Bedrock Unknown
-  Sedimentary Rocks within the Narragansett Basin
-  Crystalline Rocks (Igneous and Metamorphic Rocks)

Scale in miles



BLOCK ISLAND

## Stratigraphic Section at the Base

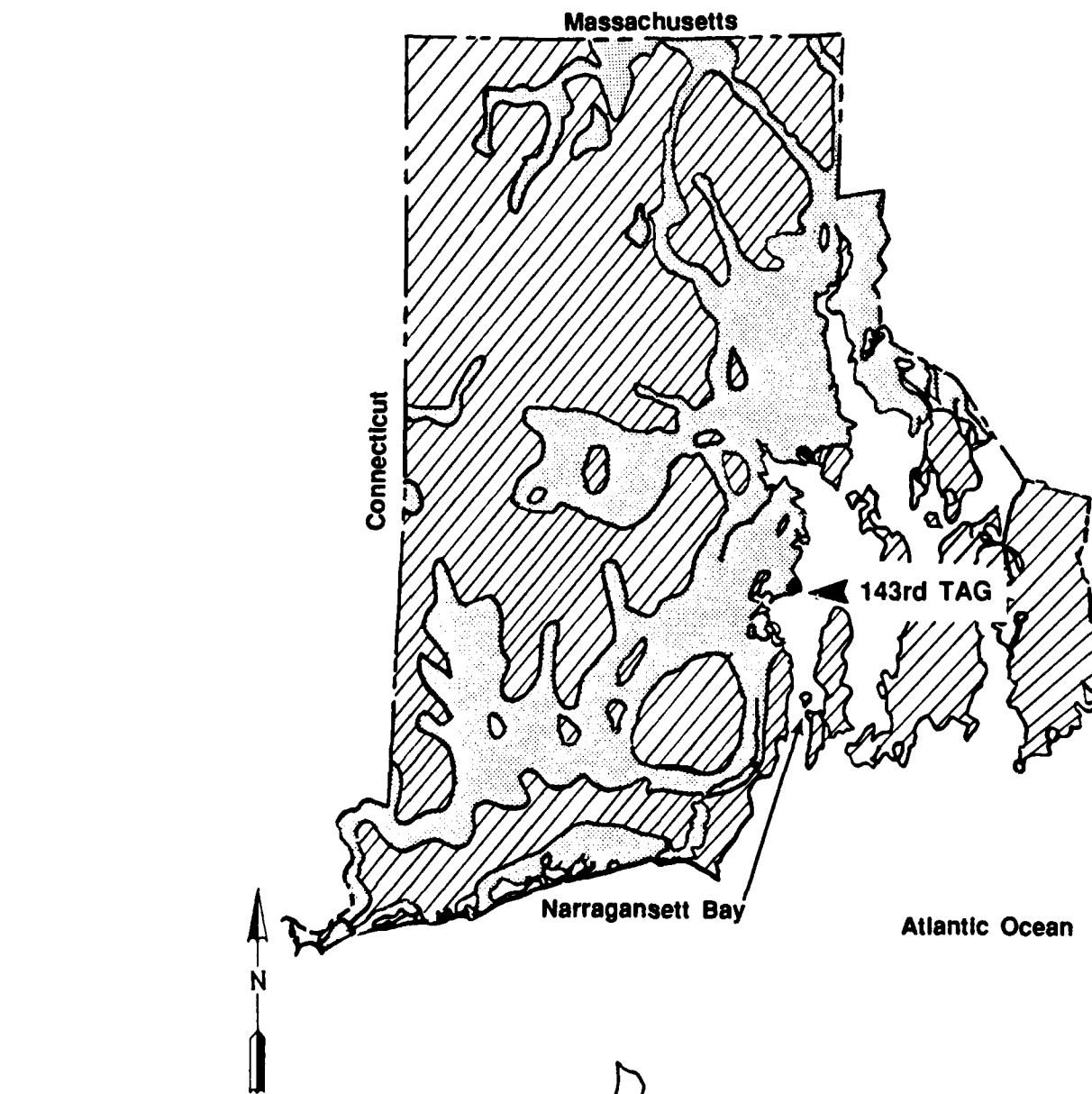
SYSTEM	SUBDIVISION	LITHOLOGY
PENNSYLVANIAN	Rhode Island Formation	<p>Pra, argillaceous facies: dark greenish-gray to black phylitic beds of originally argillaceous sediments.</p> <p>Pr, undifferentiated facies: includes light- to dark-gray meta sandstone and conglomerate and mica schists; may include Pondville Conglomerate in covered areas.</p>
	Pondville Conglomerate	Pp, light- to dark-green schistose and conglomeratic quartzite.
MISSISSIPPIAN or OLDER	Ten Rod Granite Gneiss	<p>tgn, nonporphyritic facies: cream colored gneiss; major constituents are smoky quartz, plagioclase, and microcline.</p> <p>tgf, fine-grained facies, tan to buff; some red stain.</p> <p>tg, porphyritic facies, gray, strongly foliated; major constituents are quartz, phenocrysts of microcline and plagioclase, and biotite.</p>
	Hope Valley Alaskite Gneiss	hva, flesh-colored to orange gneiss, with rod-shaped aggregates of quartz; low biotite content; major minerals are microcline, plagioclase, and quartz.
PRECAMBRIAN	Biotite Gneiss	bg, light-gray gneiss, with bands of biotite schist; porphyroblastic quartz and feldspar stand out in relief; major constituents are quartz, microcline, micropertite, plagioclase, and biotite.

from one locality to another. The thickness of individual beds ranges from a few inches to four feet (Williams, 1964).



The consolidated bedrock throughout most of Rhode Island is overlain by unconsolidated sediments. Their thickness ranges from several inches to more than 200 feet. Generally, these sediments are thicker in the major valleys than they are on the highlands. The unconsolidated sediments are primarily Pleistocene glacial drift. However, some Recent gravel, silt, sand, clay, and peat deposits occur along rivers and in ponds and marshes. Because of the complex set of natural conditions under which Pleistocene glacial drift and Recent sediments were deposited, vertical and horizontal facies changes frequently occur from one locality to another. Based on their origin, Pleistocene glacial drift deposits are subdivided into two groups: till and outwash. The Base is underlain by Pleistocene glacial outwash. The areal distribution of these deposits in Rhode Island is illustrated in Figure 5 (Allen, 1953).

Pleistocene outwash deposits consist of stratified sections of gravel, sand, silt, and clay. The thickness of individual beds varies greatly from one locality to another. These beds are frequently lenticular and pinch out at comparatively short distances. Outwash deposits primarily occur in the lowlands bordering Narragansett Bay and in the larger river valleys. The thickest sections of outwash deposits occur within these valleys (Allen, 1953).

Eight wells were drilled in close proximity to the Base that penetrated the glacial outwash. The location of these wells in relation to the Base are shown on Figure 6. Wells #2, #4, #6, #7, and #8 were drilled as test wells, while wells #11, #12, and #14 were drilled as production wells. Available information indicates that each of these wells are abandoned. Well #2 is located approximately 700 feet southeast of the Base. It was drilled in 1940 to a depth of 64 feet. Sand and gravel was encountered to a depth of 16 feet, fine sand from 16 to 20 feet, coarse sand and gravel from 20 to 38 feet, and fine sand from 38 to 64 feet. Well #4, drilled in 1940 to a total depth of 98 feet, is located approximately 2,500 feet south of the Base. Sand and gravel was found from the surface to a depth of 16 feet, fine sand was penetrated from 16 to 98 feet, and bedrock was reached at 98 feet. Well #6 is located



**Legend**

-  Till  
(Includes Exposures of Bedrock)
-  Outwash  
(Includes Alluvium)

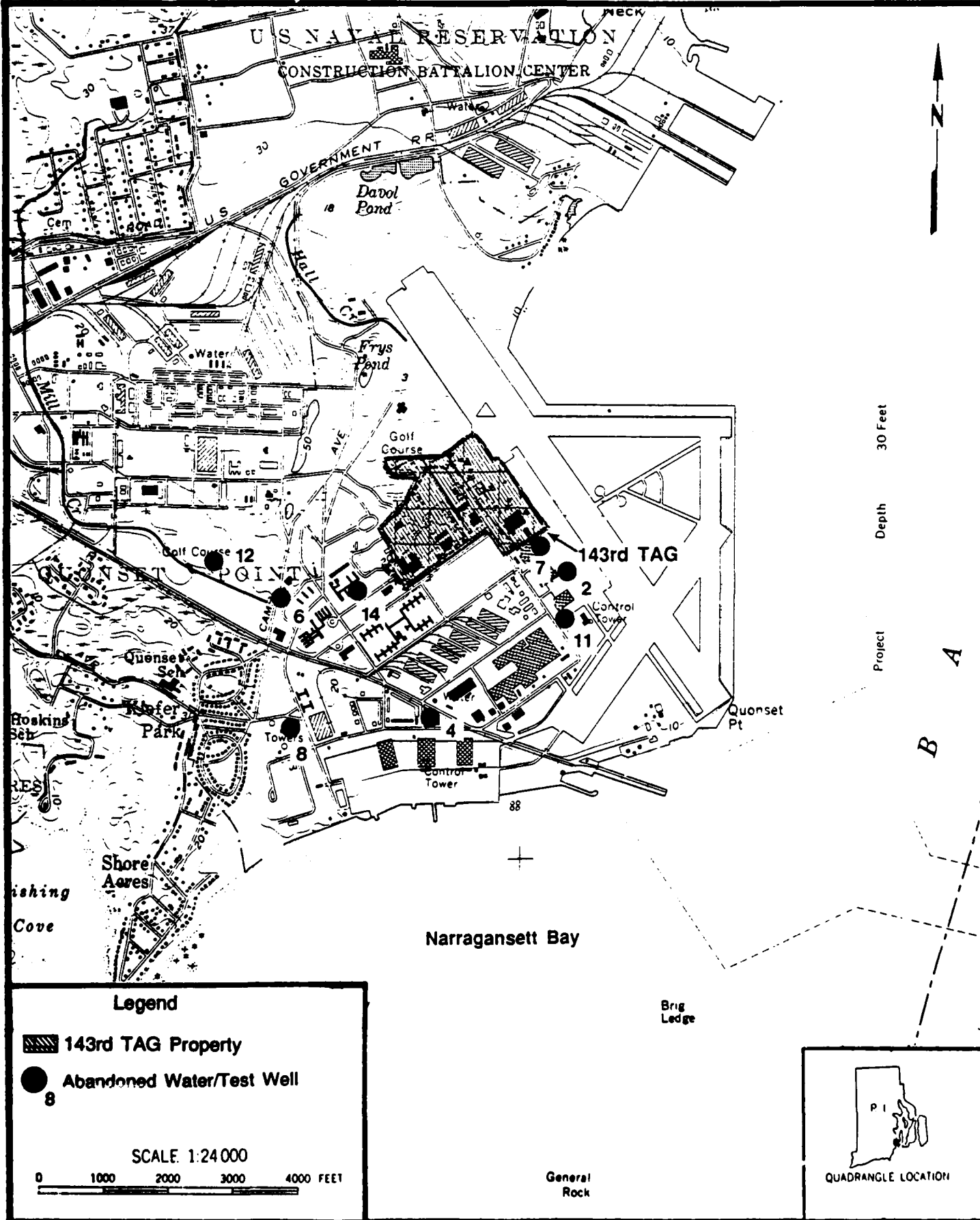
Scale in miles



HMTD

Source: Johnson and Marks, 1959;  
USGS, 1975.

Figure 6.  
Locations of Water Wells  
(143rd TAG and Vicinity)



approximately 1,600 feet southwest of the Base and was drilled in 1940 to a total depth of 38 feet. Sand and gravel were encountered to a depth of 20 feet, fine sand from 20 to 35 feet, and hardpan from 35 to 38 feet. Well #7, drilled in 1940 and located 200 feet southeast of the Base, reached a total depth of 50 feet. Sand was found from the surface to 35 feet, sand and gravel with clay from 35 to 40 feet, fine sand from 40 to 45 feet, and hardpan from 45 to 50 feet. Well #8 is located approximately 2,800 feet southwest of the Base and was drilled to a total depth of 36.8 feet. The date the well was drilled and a description of the lithologic units encountered are not available. Well #11, which was drilled in 1941, is located approximately 1400 feet southeast of the Base. Sand and gravel were encountered from the surface to a depth of 38 feet. This well tested a 350 GPM yield from the outwash. It was abandoned before use due to a high chloride concentration. Well #12, which was drilled in 1950 to a depth of 36 feet, is located approximately 2500 feet west of the Base. Fine sand was present from the surface to a depth of 23 feet. Sand and gravel were penetrated from 23 to 36 feet (Allen, 1953). A yield of 500 GPM was obtained from the outwash, and water from the well was supplied to the Base during construction. After construction of the Base was completed, the well was abandoned. Well #14 was drilled in 1941 and is located approximately 500 feet southwest from the Base. This well was drilled to a depth of 363 feet, and a break down of the lithologies encountered is not available. The chief aquifer is designated as sand and gravel from 80 to 363 feet; however, bedrock was likely encountered in that interval. From that interval, the well yielded 80 GPM and was used to fill the Base swimming pool before being abandoned (USGS Water Well Records).

Strong wind movement, which occurred at the end of the Pleistocene glaciation, deposited heterogeneous sand and silt at the Base and on the surrounding area. The thickness of these deposits ranges from less than 10 feet at the higher elevations to more than 150 feet in portions of the bedrock valleys. Generally, these deposits are thin in the area of the Base (TRC Environmental Consultants, 1988).

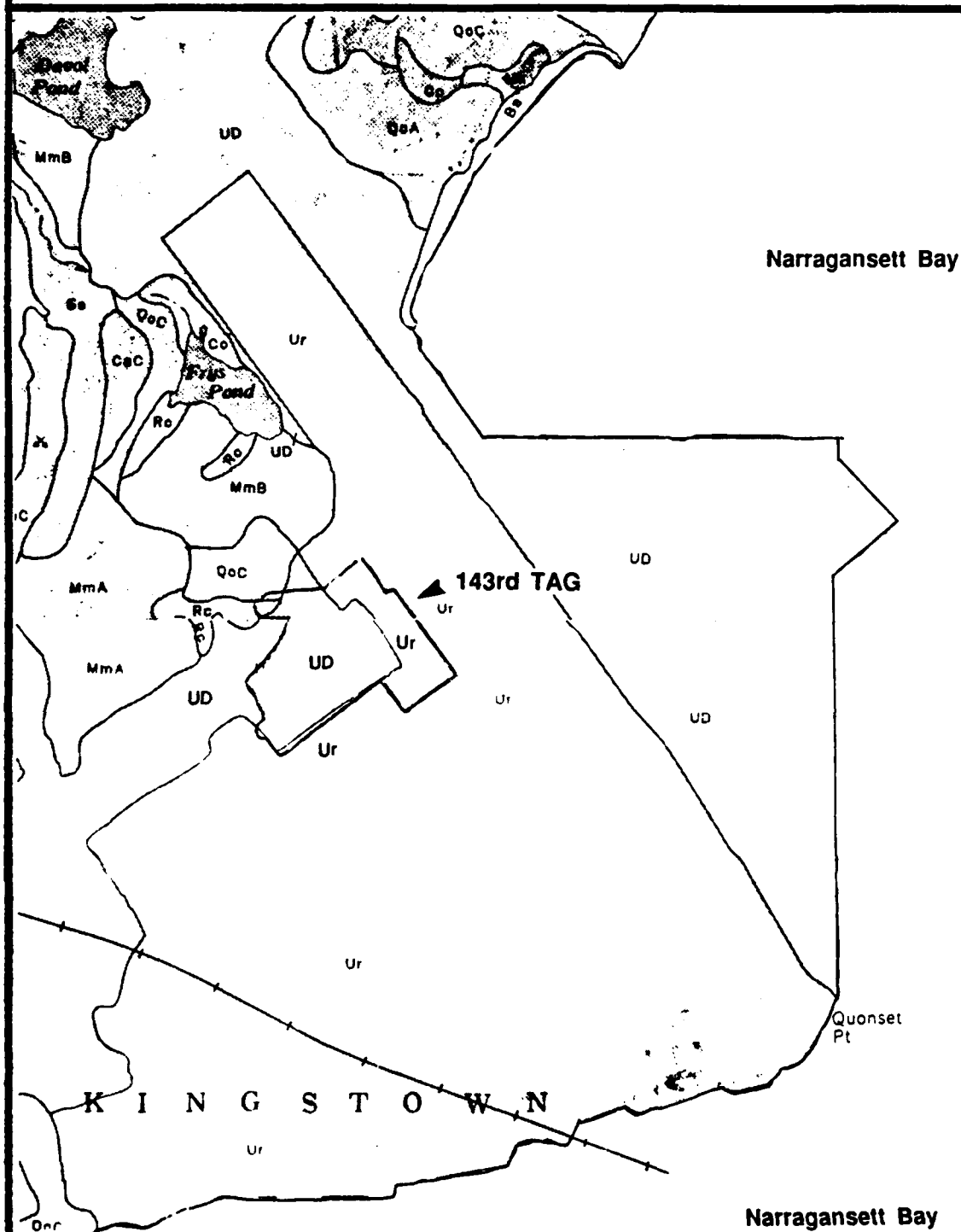
### **C. Soils**

According to the USDA, Soil Conservation Service (Rector, 1981), the soils at the Base are Udorthents-Urban land complex, Urban land, Quonset gravelly sandy loam, and Raypol

HMTC

Source: Rector, 1981.

Figure 7.  
Soil Survey Map of  
Quonset State Airport



**Legend**

QoC Quonset gravelly sandy loam, rolling  
Rc Raypol silt loam  
UD Udorthents-Urban land complex  
Ur Urban land



silt loam (Figure 7). While these soils are present at the Base, the property is extensively covered with concrete, asphalt, and buildings. The actual amount of uncovered soil is very small.

The Udorthents-Urban land complex consists of moderately well-drained to excessively drained soils that have been disturbed by cutting or filling and areas that are covered by buildings and pavement. The soil is composed of 70 percent Udorthents, 20 percent Urban, and 10 percent other soils. Udorthents consist mainly of moderately coarse-textured soil and some medium-textured soil.

Urban land consists of sites for buildings, paved roads, and parking lots. Slopes range from 0 to 5 percent. Included in this unit are small, intermingled areas of Udorthents; somewhat excessively drained Merrimac soils; well-drained Canton, Charlton, and Newport soils; and moderately well-drained Pittstown, Sudbury, and Sutton soils.

The Merrimac soils are excessively drained and occur on undulating terraces and outwash plains. Typically, the surface layer is dark brown sandy loam underlain by yellowish-brown and dark yellowish-brown sandy loam. Permeability is rapid ( $2.54 \times 10^{-1}$  to  $8.47 \times 10^{-1}$  cm/sec), and soil erosion is slight.

Canton and Charlton soils range from sandy loam with areas of hard, exposed bedrock to sandy loams to stony, fine sandy loams. These soils have a very dark grayish-brown, fine sandy loam surface underlain by dark yellowish-brown, fine sandy loam. These soils vary in the amount of rock present. Rock content ranges from bedrock outcroppings to stones and boulders to no rocks at all. Permeability is moderately rapid ( $8.47 \times 10^{-2}$  to  $2.54 \times 10^{-1}$  cm/sec), and soil erosion is slight.

Newport soils consist of a silt loam with a very dark brown surface and an olive-brown and olive subsurface. The permeability is moderate ( $2.54 \times 10^{-2}$  to  $8.47 \times 10^{-2}$  cm/sec) to moderately rapid ( $8.47 \times 10^{-2}$  to  $2.54 \times 10^{-1}$  cm/sec), and soil erosion is slight.

Pittstown soils consist of very dark grayish-brown silt loam on the surface underlain by dark yellowish-brown and olive-brown silt loam. The permeability is moderate ( $2.54 \times 10^{-2}$  to  $8.47 \times 10^{-2}$  cm/sec), and soil erosion is slight.

Sudbury soils typically have a dark brown sandy loam surface and a dark yellowish-brown sandy loam to a yellowish-brown, mottled gravelly sand subsurface. Permeability is moderately rapid ( $8.47 \times 10^{-2}$  to  $2.54 \times 10^{-1}$  cm/sec), and soil erosion is slight.

Sutton soils are typically very dark grayish-brown sandy loams on the surface with a dark brown to yellowish-brown, fine sandy loam subsurface. The permeability is moderate ( $2.54 \times 10^{-2}$  to  $8.47 \times 10^{-2}$  cm/sec) to moderately rapid ( $8.47 \times 10^{-2}$  to  $2.54 \times 10^{-1}$  cm/sec), and soil erosion is moderate.

The Quonset gravelly sandy loam consists of excessively drained soils derived from glaciofluvial deposits that were derived mainly from phyllite, shale, schist, and gneiss. Typically, the surface layer is a very dark gray, gravelly sandy loam about 3 inches thick. The subsoil is dark yellowish-brown and light olive-brown, gravelly loamy sand about 13 inches thick. The substratum is dark gray, very gravelly sand to a depth of 60 inches or more. The permeability is moderately rapid ( $8.47 \times 10^{-2}$  to  $2.54 \times 10^{-1}$  cm/sec) to rapid ( $2.54 \times 10^{-1}$  to  $8.47 \times 10^{-1}$  cm/sec). The soil erosion is slight.

The Raypol silt loam consists of nearly level, poorly drained soils formed from windblown or water-deposited silts derived mainly from schist, gneiss, and shale. The surface layer is typically very dark grayish-brown silt loam about 4 inches thick. The subsoil is 18 inches of light olive-brown, mottled silt loam. The substratum is grayish-brown and yellowish-brown, mottled gravelly sand to a depth of 60 inches or more. The permeability rate is moderate ( $2.54 \times 10^{-2}$  to  $8.47 \times 10^{-2}$  cm/sec). The soil erosion is moderate.

Eleven soil borings were done under the apron in the area north of the hangar (P-13). These soil boring logs are found in Appendix F. Information from these borings indicates that the surface soil is gravelly sand; sand; or gravelly, sandy fill. These soils are found at depths of about 1.5 feet beneath the concrete and range in thickness from 0.5 to 3.5 feet. The subsoil consists of silty, sandy fill; sandy fill; gravelly, sandy fill; or silty, gravelly sand fill. Its thickness ranges from 3 to 5.5 feet. The substratum consists of silty, fibrous sand; stratified sand; sand; or gravelly sand with a thickness of 3.5 to 12 feet. Below the 12- to 15-foot mark, the soil consists of organic silt and sand with organic silt (Gordon R. Archibald, Inc., 1988).

## **D. Hydrology**

### **1. Surface Water**

The largest body of surface water near the Base (approximately 1200 feet to the east at its closest point) is the Narragansett Bay, which surrounds Quonset Point on three sides. This bay flows into Rhode Island Sound and the Atlantic Ocean. Because of its close proximity to the ocean, the bay is a tidal salt water body. It is used for recreation and fish propagation.

Another, much smaller surface water body is Frys Pond, which is located approximately 0.5 miles north of the Base. Three-fifths of a mile north of Frys Pond is Davol Pond. Both ponds are connected by Hall Creek, which is located north of the Base. Frys Pond is connected to the Bay by underground pipe approximately 0.25 miles in length. These ponds are not used for recreation, fish propagation, or potable water supplies.

Surface runoff from the Base and the U.S. Naval Reservation, Quonset Point Naval Air Station flows into Frys Pond, Davol Pond, Mill Creek, and directly into Narragansett Bay. Mill Creek and the overflow from Davol Pond and Frys Pond flows directly into Narragansett Bay. Mill Creek flows into Narragansett Bay approximately two miles southwest of the Base. The Base and the Quonset Point Naval Air Station are located in the Narragansett Bay drainage basin.

Surface runoff at the Base is collected in a series of drainage swales and storm drains. The storm drains at the Base are shown in Figure 8. All of the surface runoff that is collected on Base exits the Base through a 60-inch storm drain outfall at the Base's northern boundary. This runoff flows into Frys Pond approximately 0.5 mile northwest of the Base.

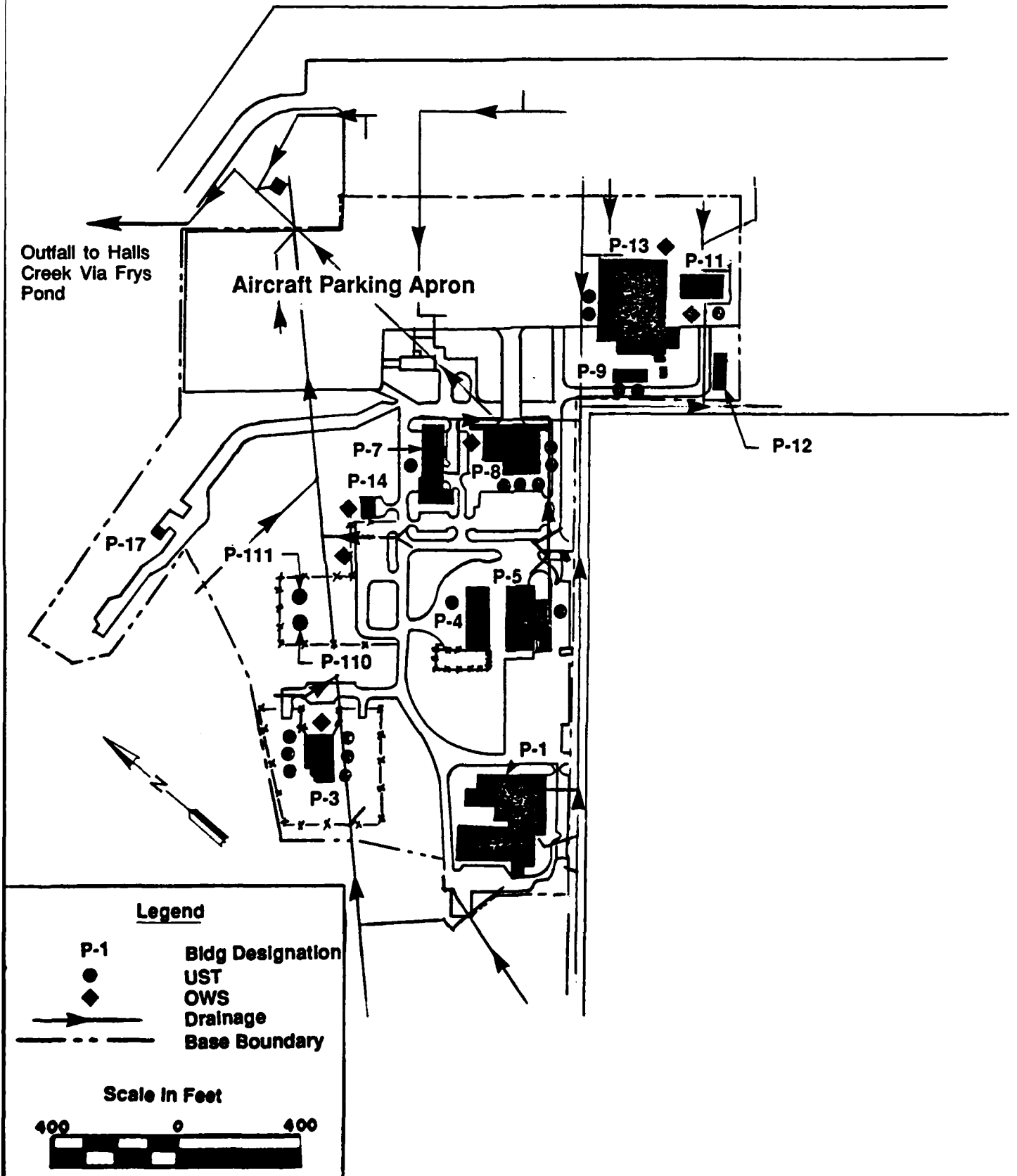
The potential for flooding from the ponds and creeks is very slight. However, the Base lies within the 100-year flood plain of the Bay (Personal Communication, Rhode Island Department of Natural Resources, Fresh Water Wetlands Section, 1988).

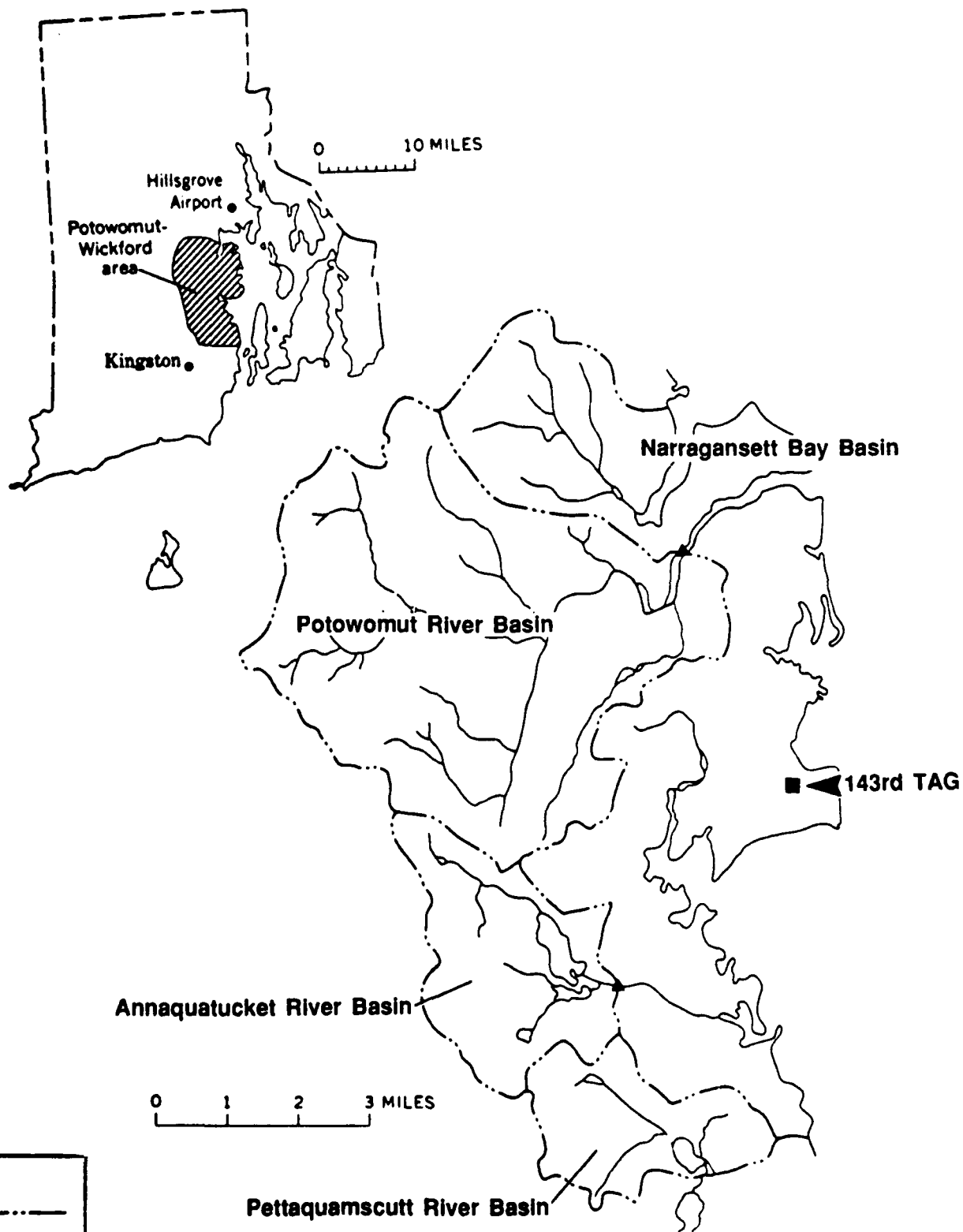
## 2. Groundwater

The Base is located above the Potowomut-Wickford Aquifer System. The areal distribution of this aquifer is illustrated in Figure 9. This aquifer underlies portions of the Potowomut River Basin, the Annaquatucket River Basin, the Pettaquamscutt River Basin, and the Narragansett Bay Basin. The aquifer encompasses both the surficial Pleistocene glacial drift and the underlying bedrock. It consists chiefly of four geologic materials: (1) stratified sand and gravel interbedded with fine sand and silt, (2) till, (3) stratified sand and gravel interbedded with till, and (4) bedrock. The majority of water wells drilled in the area surrounding the Base tap permeable intervals of stratified sand and gravel interbedded with fine sand and silt. Some of these wells tap fractured intervals within the underlying Pennsylvanian bedrock (Rosenshein et al, 1968).

The water table is less than 10 feet below the land surface as illustrated in Figure 10 (Rosenshein et al, 1968). Areas where the aquifer is absent are also delineated in Figure 10. The water table contour lines are inferred through these areas to provide continuity. The Potowomut-Wickford aquifer system is unconfined. It is recharged locally by the infiltration of precipitation and by some of the major rivers. This recharge, which occurs in areas directly adjoining the rivers, develops when excess well pumping lowers the potentiometric surface below the river level. As a result, surface water from the river infiltrates directly into the aquifer. The groundwater flows west to east and discharges into Narragansett Bay (Allen, 1953).

There are no water wells on Base property. However, as illustrated in Figure 6, numerous wells have been drilled in the area surrounding the Base. They tap both the surficial unconsolidated glacial drift and the underlying bedrock. The yield for wells developed in the glacial drift depends upon the portion of coarse-grained material to fine-grained material in which the wells were drilled (Allen, 1953). Wells that tap glacial till generally produce less than 2 gpm. In contrast, wells that tap stratified, coarse sand and gravel intervals frequently yield in excess of 2700 gpm. The average yield for wells that tap the igneous and metamorphic bedrock is 12 gpm. The average yield for wells that tap the Pennsylvanian bedrock is 31 gpm (Allen, 1953).



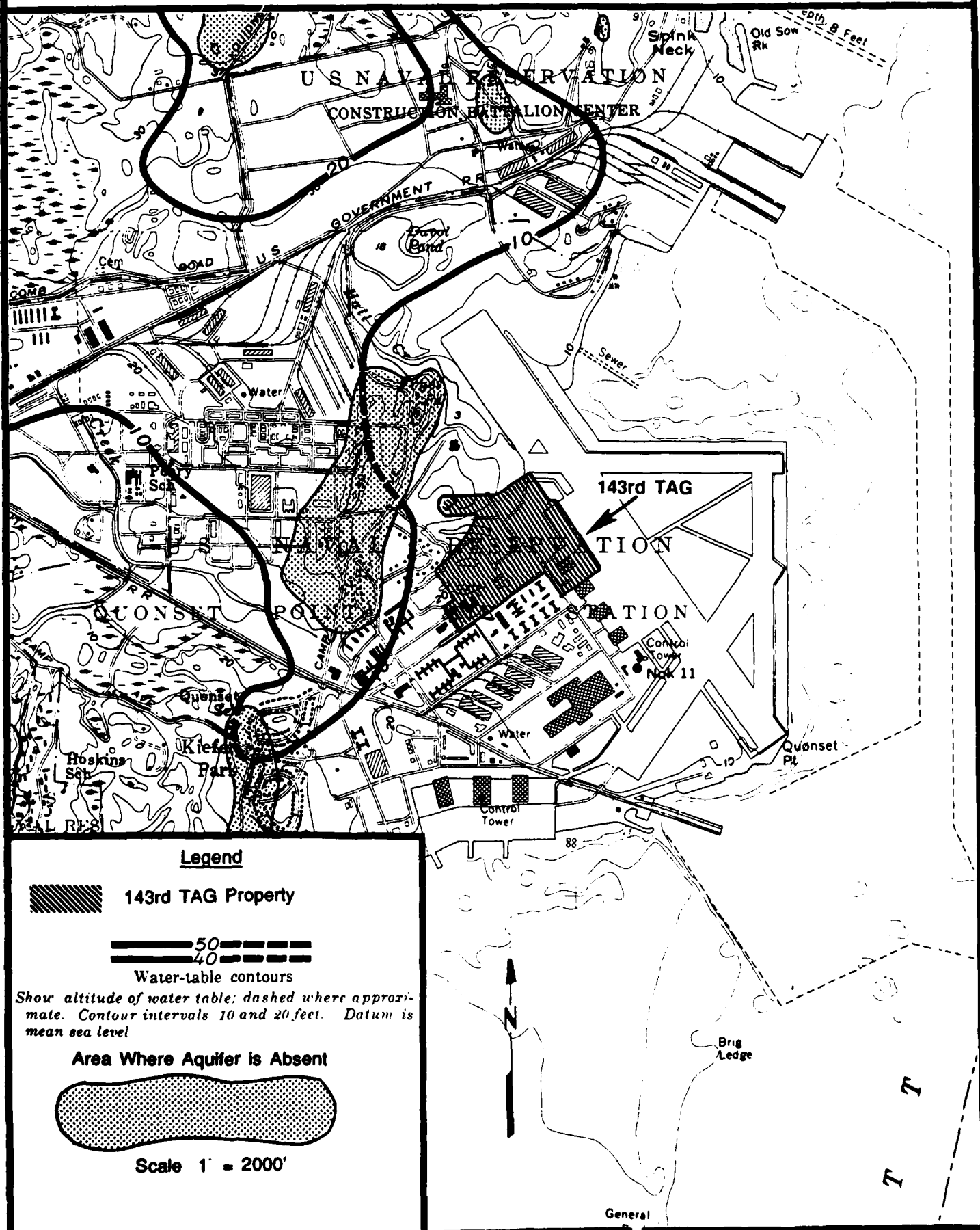


**Legend**

Basin boundary



Gaging station



Well Nos. 4 and 11, which were previously described on page III-6 of the geology section, tap coarse sand and gravel intervals at depths approximately 40 feet below the land surface. The locations of these wells in relation to the Base is shown on Figure 6. Presently, each of these wells is abandoned and not in use. They were abandoned because excessive well pumping resulted in salt water encroachment and chloride concentrations in excess of 750 ppm (Allen, 1953).

The Base purchases its water from the North Kingstown Water Commission. The North Kingstown Water Commission obtains its water from a well field near Bellenville Pond, approximately 3.5 miles southwest of the Base.

Water from the Potowomut-Wickford aquifer is adequate for most purposes. Generally, the concentration of dissolved solids is less than 70 ppm. Normally, the water is slightly acidic with a pH in the range of 5.5 to 7.0. The principal anions are bicarbonate, sulphate, and chloride. Normally, the concentration of each of these anions is less than 25 ppm. In the vicinity of Narragansett Bay, the chloride concentrations frequently exceed 250 ppm. Once again, this high chloride concentration is the result of salt water encroachment. Excessive well pumping has lowered the aquifer's potentiometric surface and thus altered the natural groundwater - saltwater interface. The principal cations are calcium, sodium, magnesium, and potassium. Generally their concentrations are less than 10 ppm (TRC Environmental Consultants, 1988).

#### **IV. SITE EVALUATION**

##### **A. Activity Review**

A review of Base records and interviews with Base personnel resulted in the identification of specific operations at the Base in which the majority of industrial chemicals are handled and hazardous wastes are generated. Twenty-five past and present Base personnel with an average of eight years experience at the Base were interviewed. (The unit has been at this location since 1980.) These personnel were representative of the following Base shops: Civil Engineering; Aircraft Maintenance; Facilities Maintenance; Vehicle Maintenance; Aerospace Ground Equipment (AGE) Maintenance; Petroleum, Oil, and Lubricant (POL) Management; Fabrication; Quality Assessment; Safety Bioenvironmental Engineering; and Operations. Table 2 summarizes these major operations, provides estimates of the quantities of waste currently being generated by these shops, and describes the past and present disposal practices for the wastes. Based on the information gathered, any shop that is not listed in Table 2 has been determined to produce negligible quantities of wastes requiring disposal.

##### **B. Disposal/Spill Site Identification, Evaluation, and Hazard Assessment**

Interviews with Base personnel and subsequent inspections of the installation resulted in the identification of no sites potentially contaminated with HM/HW. The Base is shown in Figure 8.

Although no sites were identified and assigned a HAS according to HARM, the methodology and guidelines for assigning a score are included in Appendix C. The objective of this assessment is to identify and provide a relative ranking of sites suspected of contamination from hazardous substances. The final rating score would reflect specific components of the hazard posed by a specific site: possible receptors of the contamination (e.g., population within a specified distance of the site and/or critical environments within a one-mile radius of the site); the waste and its characteristics; and the potential pathways for contaminant migration (e.g., surface water, groundwater, flooding).

**Table 2. Hazardous Materials/Hazardous Wastes Disposal Summary: 143rd TAG, Rhode Island Air National Guard, Quonset State Airport, North Kingstown, Rhode Island**

Shop Name and Location	Hazardous Waste/ Used Hazardous Material	Current Estimated Quantities (Gallons/Year)	Method of Treatment/Storage/Disposal				
			1950	1960	1970	1980	1988
Aircraft Maintenance Bldg. P-8	PD-680	55	*	*	*	-----DRMO-----	
	MEK, MIBK	55				-----DRMO-----	
	Hydraulic Oil	100				-----CONTR-----	
	Engine Oil	200				-----CONTR-----	
Aerospace Ground Equipment (AGE) Bldg. P-9	Engine Oil	100	*	*	*	-----CONTR-----	
	Hydraulic Oil	30				-----CONTR-----	
	Battery Acid	15				-NEUT/DRMO--	
Vehicle Maintenance Bldg. P-3	Engine Oil	800	*	*	*	-----CONTR-----	
	Battery Acid	50				-NEUT/DRMO--	
	Hydraulic Oil	50				-----CONTR-----	
Fuels Management Bldg. P-14	JP-4	12,00	*	*	*	-----FTA-----	

**KEY:**

- CONTR - Disposed of through a private contractor.
- DRMO - Disposed of through the Defense Reutilization and Management Office (DRMO).
- FTA - Disposed of at the Fire Training Area. This is an off-site facility.
- SIL REC - Disposed of through DRMO for silver recovery.
- STORM - Disposed of through the storm sewer.
- NEUT - Acid neutralized with bicarbonate before disposal.

\* Base not operational until 1980.

Table 2. (continued)

Shop Name and Location	Hazardous Waste/ Used Hazardous Material	Current Estimated Quantities (Gallons/Year)	Method of Treatment/Storage/Disposal			
			1950	1960	1970	1980
Nondestructive Inspection (NDI) MEK Bldg. P-7	MEK	110	*	*	*	-----DRMO-----
	Penetrant	50				-----DRMO-----
	Emulsifier	50				-----STORM----
	Fixer	15				----SIL REC--
Paint Shop Bldg. P-13	Thinners	110	*	*	*	-----DRMO-----
	Paint Cans	35				-----DRMO-----
	MEK	220				-----DRMO-----
	Stripper Residue	50				-----DRMO-----
Battery Shop Bldg. P-13	Used Batteries	20	*	*	*	-----DRMO-----
	Battery Acid	30				-NEUT/DRMO--

## KEY:

- CONTR - Disposed of through a private contractor.
- DRMO - Disposed of through the Defense Reutilization and Management Office (DRMO).
- FIA - Disposed of at the Fire Training Area. This is an off-site facility.
- SIL REC - Disposed of through DRMO for silver recovery.
- STORM - Disposed of through the storm sewer.
- NEUT - Acid neutralized with bicarbonate before disposal.

\* Base not operational until 1980.

Table 2. (continued)

Shop Name and Location	Hazardous Waste/ Used Hazardous Material	Current Estimated Quantities (Gallons/Year)	Method of Treatment/Storage/Disposal	1950	1960	1970	1980	1988
Photographic Laboratory Bldg. P-7	Developer	26	*	*	*	*	-----STORM----	-----STORM----
	Fixer	60					-----SIL REC----	-----SIL REC----
Propulsion Shop Bldg. P-13	P0-680	50	*	*	*	*	-----DRMO-----	-----DRMO-----
	Hydraulic Oil	50					-----CONTR-----	-----CONTR-----
	Engine Oil	200					-----DRMO-----	-----DRMO-----

## KEY:

- CONTR - Disposed of through a private contractor.
- DRMO - Disposed of through the Defense Reutilization and Management Office (DRMO).
- FIA - Disposed of at the Fire Training Area. This is an off-site facility.
- SIL REC - Disposed of through DRMO for silver recovery.
- STORM - Disposed of through the storm sewer.
- NEUT - Acid neutralized with bicarbonate before disposal.

\* Base not operational until 1980.

### **C. Critical Habitats/Endangered or Threatened Species**

There are no endangered plant or animal species within a one-mile radius of the Base. Three species of birds identified within a one-mile radius of the Base are State-threatened. They are *Ammodramus savannarum* (Grasshopper Sparrow), *Bartramia longicauda* (Upland Sandpiper), and *Sterna albifrons* (Least Tern). Presently there are three to four pairs of Grasshopper Sparrows, two pairs of Upland Sandpipers, and 50+ pairs of Least Terns nesting around the runways. The Least Terns' nesting area is to the east of the Base and outside the one-mile radius (Raithel, 1988).

There are no wilderness areas within a one-mile radius of the Base. Wetlands are located 0.5 miles west of the Base and approximately 1.25 miles northwest of the Base.

### **D. Other Pertinent Information**

The Base uses a double oil/water separator (OWS) system to treat wastewater from the storm sewer before discharging it into Frys Pond. The OWSs for this system are located at the Motor Pool, the POL Facility, the Corrosion Control Shop, the A/C Maintenance Shop, and the AGE Shop. The main OWS is located on the north corner of the Base. The OWSs are emptied monthly by a DRMO contractor, and the waste is transferred to a 1000-gallon underground storage tank (UST). An inventory of the OWSs is included as Appendix E, and their locations are shown on Figure 8.

Since 1986, the Base has had a National Pollutant Discharge Elimination System (NPDES) Permit for discharge of the water from the OWSs and storm water into Frys Pond. The water is tested biannually; the results have always been in compliance.

The Base operates a temporary hazardous waste storage area in a secured bunker. Hazardous wastes are accumulated here until pickup by a DRMO contractor. The wastes are accumulated in 5-gallon and 55-gallon containers at the point of generation and then transferred to the bunker. The bunker is inventoried and cleaned weekly. The bunker consists of 3-foot concrete walls, a locked door, berming to hold 5 percent of the bunker's contents, and ventilation.

Waste oil is accumulated in a 250-gallon bowser stored in Building P-27, which is a corrugated metal shed, and in a 1000-gallon underground storage tank (UST) located at the Motor Pool (Bldg. P-3). If necessary, the contents are transferred from the bowser into the tank. Arrangements for emptying the tank and bowser are handled by Supply. A DRMO contractor empties the tank and bowser.

Herbicides are applied by a contractor biannually and consist of Trimic 992 and 875, Bucryl, Dursban 4E, and Ampel.

The Base operates 20 active USTs containing MOGAS, AVGAS, heating oil, and detergents. These tanks range from 1000 to 12,000 gallons in capacity. There are no abandoned USTs located on the Base. A complete inventory of the USTs is included as Appendix E, and their locations are shown on Figure 8.

The Air National Guard has conducted its fire training exercises at an off-site, joint-use facility.

No radioactive disposal areas have been operated on Base property.

The Base's water is supplied by the city of North Kingstown Water Commission well field, located at Belleville Pond. The well field is up gradient of the Base, approximately 3.5 miles southwest of the Base.

## V. CONCLUSIONS

Information obtained through interviews with 25 past and present Base personnel, a review of Base records, and field observations identified no contaminated disposal and/or spill sites on Base property.

## **VI. RECOMMENDATIONS**

No further IRP investigation is recommended for the Base.

## GLOSSARY OF TERMS

ANNUAL PRECIPITATION - The total amount of rainfall and snowfall for the year.

AQUIFER - Stratum or zone below the surface of the earth capable of producing water as from a well.

ARGILLACEOUS - Like or containing clay.

ARKOSE - A feldspar rich sandstone, typically coarse-grained and pink or reddish, that is composed of angular to subangular grains that may be either poorly or moderately well-sorted, is usually derived from the rapid disintegration of granite or granitic rocks, and often closely resembles granite.

BASIN - (a) A depressed area with no surface outlet; (b) A drainage basin or river basin; (c) A low area in the Earth's crust, of tectonic origin, in which sediments have accumulated.

BAY - A wide, curving, open indentation, recess, or inlet of a sea or lake into the land or between two capes or headlands, larger than a cove, and usually smaller than, but of the same general character as a gulf.

BED [stratig] - The smallest formal unit in the hierarchy of lithostratigraphic units. In a stratified sequence of rocks, it is distinguishable from layers above and below. A bed commonly ranges in thickness from a centimeter to a few meters.

BEDDING [stratig] - The arrangement of sedimentary rock in beds or layers of varying thickness and character.

BEDROCK - A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.

BOULDER - A detached rock mass larger than a cobble, having a diameter greater than 256 mm, being somewhat rounded or otherwise distinctly shaped by abrasion in the course of transport.

CLASTIC - Consisting of fragments of rocks or of organic structures that have been moved individually from their places of origin.

CLAY [soil] - A rock or mineral particle in the soil having a diameter less than 0.002 mm (2 microns).

CLAY [geol] - A rock or mineral fragment or a detrital particle of any composition smaller than a fine silt grain, having a diameter less than 1/256 mm (4 microns).

COARSE-TEXTURED SOIL - Sand or loamy sand.

CONGLOMERATE - A coarse-grained sedimentary rock, composed of rounded pebbles, cobbles, and boulders, set in a fine-grained matrix of sand or silt, and commonly cemented by calcium carbonate, iron oxide, silica, or hardened clay.

CONSOLIDATION - Any process whereby loosely aggregated, soft, or liquid earth materials become firm and coherent rock; specifically, the solidification of a magma to form an igneous rock or the lithification of loose sediments to form a sedimentary rock.

CONTAMINANT - As defined by Section 101(f)(33) of Superfund Amendments and Reauthorization Act of 1986 (SARA) shall include, but not be limited to any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction), or physical deformation in such organisms or their offspring; except that the term "contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under:

- (a) any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act,

- (b) any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act,
- (c) any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress),
- (d) any toxic pollutant listed under Section 307(a) of the Federal Water Pollution Control Act,
- (e) any hazardous air pollutant listed under Section 112 of the Clean Air Act, and
- (f) any imminently hazardous chemical substance or mixture with respect to which the administrator has taken action pursuant to Section 7 of the Toxic Substance Control Act;

and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

CREEK - A term generally applied to any natural stream of water, normally larger than a brook but smaller than a river.

CRITICAL HABITAT - The specific areas within the geographical area occupied by the species on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management consideration or protection.

DEPOSITS - Earth material of any type, either consolidated or unconsolidated, that has accumulated by some natural process or agent.

DIABASE - An intrusive rock whose main components are labradorite and pyroxene and which is characterized by ophitic texture.

DIORITE - A group of igneous rocks composed of dark-colored amphibole (especially hornblende) oligoclase, andesine, pyroxene, and small amounts of quartz; the intrusive equivalent of andesite.

soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained* - Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained* - Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well-drained* - Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well-drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained* - Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained* - Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained* - Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough periods during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results

most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained* - Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

**DRAINAGEWAY** - A channel or course along which water moves in draining an area.

**ENDANGERED SPECIES** - Any species which is in danger of extinction throughout all or a significant portion of its range, other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection would present an overwhelming and overriding risk to man.

**EROSION** - The general process or the group of processes whereby the materials of the Earth's crust are loosened, dissolved, or worn away, and simultaneously moved from one place to another by natural agencies, but usually exclude mass wasting.

**ESCARPMENT** - a steep face terminating high lands abruptly.

**FACIES** - General appearance or nature of one part of a rock body as contrasted with other parts. Parts of a rock body as differentiated from other parts by appearance or composition.

**FELDSPAR** - Any of several crystalline minerals made up of aluminum silicates with sodium, potassium, or calcium, usually glassy and moderately hard, found in igneous rocks.

**FELDSPATHIC** - Like or as feldspar.

**FINE-GRAINED** - Said of a soil in which silt and/or clay predominate.

**FINE-TEXTURED SOIL** - Sandy clay, silty clay, and clay.

FLOOD PLAIN - The surface or strip of relatively smooth land adjacent to a river channel, constructed by the present river in its existing regimen and covered with water when the river overflows its banks.

FOLD [geol struc] - A curve or bend of a planar structure such as rock strata, bedding planes, foliation, or cleavage.

FORMATION - A lithologically distinctive, mappable body of rock.

FRACTURE [struc geol] - A general term for any break in a rock, whether or not it causes displacement, due to mechanical failure by stress. Fracture includes cracks, joints, and faults.

GABBRO - A group of dark-colored, basic intrusive igneous rocks composed principally of basic plagioclase and clinopyroxene, with or without olivine and orthopyroxene; approximate intrusive equivalent of basalt.

GEOSYNCLINAL BASIN - Large, generally linear trough or basin that subsided deeply throughout a long period of time in which a thick succession of stratified sediments and possibly extrusive volcanic rocks commonly accumulate.

GLACIAL - (a) Of or relating to the presence and activities of ice or glaciers, (b) Pertaining to distinctive features and materials produced or derived from glaciers and ice sheets.

GLACIAL DRIFT - A general term for drift transported by glaciers or icebergs and deposited on land or in the sea.

GLACIOFLUVIAL DEPOSITS - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

GNEISS - A coarse-grained, foliated rock produced by regional metamorphism; commonly feldspar- and quartz-rich.

GRANITE - Broadly applied, any crystalline, quartz-bearing plutonic rock; also commonly contains feldspar, mica, hornblende, or pyroxene.

GRANODIORITE - A group of coarse-grained plutonic rocks intermediate in composition between quartz diorite and quartz monzonite, containing quartz, plagioclase, and potassium feldspar with biotite, hornblende, or more rarely, pyroxene, as the mafic contents.

GRASSHOPPER SPARROW - A small, hardy bird (*Ammodramus savannarum*) of the family Paset; related to finches, grosbeaks, and buntings; introduced from Europe to the United States.

GRAVEL - An unconsolidated, natural accumulation of rounded rock fragments resulting from erosion, consisting predominantly of particles larger than sand, such as boulders, cobbles, pebbles, granules or any combination of these fragments.

GRAYWACKE - A non-porous, dark-colored sandstone containing angular grains and fragments of other rocks; a fine-grained conglomerate resembling sandstone.

GROUNDWATER - Refers to the subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated.

HARM - Hazard Assessment Rating Methodology - A system adopted and used by the United States Air Force to develop and maintain a priority listing of potentially contaminated sites on installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts (DEQPPM 81-5, December 11, 1981).

HAS - Hazard Assessment Score - The score developed by using the Hazard Assessment Rating Methodology (HARM).

HAZARDOUS MATERIAL - Any substance or mixture of substances having properties capable of producing adverse effects on the health and safety of the human being. Specific regulatory definitions also found in OSHA and DOT rules.

HAZARDOUS WASTE - A solid or liquid waste that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

- a. cause, or significantly contribute to, an increase in mortality or an increase in serious or incapacitating reversible illness, or

- b. pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

HERBICIDE - A weed killer.

HIGHLAND - A general term for a relatively large area of elevated or mountainous land standing prominently above adjacent low areas; mountainous region.

HILL - A natural elevation of the land surface, rising rather prominently above the surrounding land, usually of limited extent and having a well-defined outline (rounded) and generally considered to be less than 1000 feet from base to summit.

ICE SHEET - A glacier of considerable thickness and more than 50,000 sq. km. in area, forming a continuous cover of ice and snow over a land surface, spreading outward in all directions and not confined by the underlying topography; a continental glacier.

IGNEOUS ROCK - Rock or mineral that has solidified from molten or partially molten material, i.e. from magma.

INTERBEDDED - Beds lying between or alternating with others of different character; especially rock material laid down in sequence between other beds.

LEAST TERN - A small bird (*Sterna albifrons*) allied to the gulls, but having a smaller bill and body, with wings more pointed, and tail usually deeply forked.

LOAM - A rich, permeable soil composed of a friable mixture of relatively equal proportions of sand, silt, and clay particles, and usually containing organic matter.

LOWLAND - A general term for low-lying land or an extensive region of low land, especially near the coast and including the extended plains or country lying not far above tide level.

MARBLE - A metamorphic rock consisting predominantly of fine- to coarse-grained, recrystallized calcite and/or dolomite, usually with granoblastic, saccharoidal texture.

MARSH - A water-saturated, poorly drained area, intermittently or permanently water-covered, having aquatic and grasslike vegetation, essentially without the formation of peat.

MEAN LAKE EVAPORATION - The total evaporation amount for a particular area; amount based on precipitation and climate (humidity).

METAMORPHIC ROCK - Any rock derived from pre-existing rocks by mineralogical, chemical, and/or structural changes, essentially in solid state, in response to marked changes in temperature, pressure, shearing stress, and chemical environment, generally at depth in the Earth's crust.

MIGRATION (Contaminant) - The movement of contaminants through pathways (groundwater, surface water, soil, and air).

MINERAL - A naturally occurring inorganic element or compound having an orderly internal structure and characteristic chemical composition, crystal form, and physical properties.

MISSISSIPPIAN - The fifth of seven periods into which the Paleozoic is divided in the United States and some other parts of North America; 320 - 360 million years ago. Approximately equivalent to the Lower Carboniferous of the rest of the world.

MORaine - Drift deposited chiefly by direct glacial action, and having constructional topography independent of control by the surface on which the drift lies.

MOTTLED [soil] - A soil that is irregularly marked with spots or patches of different colors, usually indicating poor aeration or seasonal wetness.

NET PRECIPITATION - Precipitation minus evaporation.

OUTCROP - That part of a geologic formation or structure that appears at the surface of the Earth; also, bedrock that is covered only by surficial deposits such as alluvium.

OUTWASH [glac geol] - A stratified detritus (chiefly sand and gravel) removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier.

OUTWASH PLAIN - A broad, gently sloping sheet of outwash deposited by meltwater streams flowing in front of or beyond a glacier and formed by coalescing outwash fans.

OVERTURNED - Said of a fold or the limb of a fold that has tilted beyond the perpendicular sequence of strata and thus appears reversed.

PD-680 - A cleaning solvent composed predominately of mineral spirits; Stoddard solvent.

PEAT - An unconsolidated deposit of semicarbonized plant remains in a water-saturated environment and of persistently high moisture content (at least 75%).

PENNSYLVANIAN - The sixth of seven periods of the Paleozoic; approximately 286 - 320 million years ago. Equivalent, approximately, to the Upper Carbonaceous outside the United States.

PERMEABILITY - The capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

PHYLLITE - an argillaceous rock intermediate in metamorphic grade between slate and schist.

PHYSIOGRAPHIC PROVINCE - Region of similar structure and climate that has a unified geomorphic history.

PLEISTOCENE - The first epoch of the Quaternary period; the Pleistocene began two to three million years ago and lasted until the start of the Holocene period some 8000 years ago.

POND - A natural body of standing fresh water occupying a small surface depression, usually smaller than a lake and larger than a pool.

PRECAMBRIAN - All rocks formed before the Cambrian Period; prior to 570 million years ago.

QUARTZ - A crystalline silica, an important rock forming mineral:  $\text{SiO}_2$ . Occurs either in transparent hexagonal crystals (colorless or colored by impurities) or in crystalline rock.

Forms the major proportion of most sands and has a widespread distribution in igneous, metamorphic, and sedimentary rocks.

QUARTZITE [meta] - A granoblastic metamorphic rock consisting mainly of quartz and formed by recrystallization of sandstone or chert by either regional or thermal metamorphism.

RECENT - An epoch of the Quaternary period which covers the span of time from the end of the Pleistocene Epoch, approximately 8000 years ago, to the present. Also called the Holocene Epoch.

RIVER - A general term for a natural, freshwater surface stream of considerable volume and a permanent or seasonal flow, moving in a definite channel toward a sea, lake, or another river.

SALINE - Salty; containing dissolved sodium chloride.

SALT WATER ENCROACHMENT - The phenomenon occurring when a body of salt water, because of greater density, invades a body of fresh water. It can occur either in surface or groundwater bodies.

SAND - A rock or mineral particle in the soil, having a diameter in the range 0.52 - 2 mm.

SANDSTONE - A medium-grained, fragmented sedimentary rock composed of abundant round or angular fragments of sand, size-set in a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material (commonly silica, iron oxide, or calcium carbonate).

SANDY LOAM - A soil containing 43 - 85% sand, 0 - 50% silt, and 0 - 20% clay, or containing at least 52% sand and no more than 20% clay and having the percentage of silt plus twice the percentage of clay exceeding 30% or containing 43 - 52% sand, less than 50% silt, and less than 7% clay.

SCHIST - A medium- or coarse-grained, strongly foliated, crystalline rock; formed by dynamic metamorphism.

SCHISTOCITY - The foliation in schist or other coarse-grained, crystalline rock due to the parallel, planar arrangement of mineral grains of the platy, prismatic, or ellipsoidal types, usually mica.

SEDIMENT - Solid, fragmental material that originates from weathering of rocks and is transported or deposited by air, water, or ice, or that accumulates by other natural agents such as chemical precipitation from solution or secretion by organisms, and that forms in layers on the Earth's surface at ordinary temperatures in a loose, unconsolidated form; (b) strictly solid material that has settled down from a state of suspension in a liquid.

SEDIMENTARY ROCK - A rock resulting in the consolidation of loose sediment that has accumulated in layers; e.g., a clastic rock (such as conglomerate or tillite) consisting of mechanically formed fragments of older rock transported from its source and deposited in water or from air or ice; or a chemical rock (such as rock salt or gypsum) formed by precipitation from solution; or an organic rock (such as certain limestones) consisting of the remains or secretions of plants and animals.

SHALE - A fine-grained, detrital sedimentary rock, formed by the consolidation (especially by compression) of clay, silt, or mud.

SILT [soil] - (a) A rock or mineral particle in the soil, having a diameter in the range 0.002-0.005 mm; (b) A soil containing more than 80% silt-size particles, less than 12% clay, and less than 20% sand.

SILT LOAM - A soil containing 50 - 88% silt, 0 - 27% clay, and 0 - 50% sand.

SLATE - A compact, fine-grained metamorphic rock that possesses slaty cleavage and hence can be split into slabs and thin plates. Most slate was formed from shale.

SOIL REACTION - The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests at pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as:

pH

Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0

Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

SOIL STRUCTURE - The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are -- platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

SOLVENT - A substance, generally a liquid, capable of dissolving other substances.

STONE - A general term for rock that is used for construction, either crushed for use as aggregate or cut into shaped blocks as dimension stone.

STRATIFIED - Formed, arranged, or laid down in layers or strata; especially said of any layered sedimentary rock or deposit.

SUBGRAYWACKE - Similar to graywacke but has less feldspar and more and better rounded quartz grains.

SUBSTRATUM - An underlayer or stratum; a stratum, as of earth or rock, lying immediately under another.

SURFACE WATER - All water exposed at the ground surface, including streams, rivers, ponds, and lakes.

SWALE - A slight, marshy depression in generally level land.

SWAMP - An area intermittently or permanently covered with water, having shrubs and trees but essentially without the accumulation of peat.

TERRACE [geomorph] - Any long, narrow, relatively level or gently inclined surface, generally less broad than a plain, bounded along one edge by a steeper descending slope and along the other by a steeper ascending slope.

TERRACE [soil] - A horizontal or gently sloping ridge or embankment of earth built along the contours of a hillside for the purpose of conserving moisture, reducing erosion, or controlling runoff.

THREATENED SPECIES - Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

TILL - Dominantly unsorted and unstratified drift, generally unconsolidated, deposited directly by and underneath a glacier without subsequent reworking by meltwater and consisting of a heterogenous mixture of clay, silt, sand and gravel, and boulders ranging widely in size and shape.

TOPOGRAPHY - The general conformation of a land surface, including its relief and the position of its natural and man-made features.

UNCONSOLIDATED - (a) Sediment that is loosely arranged or unstratified, or whose particles are not cemented together, occurring either at the surface or at depth. (b) Soil material that is in a loosely aggregated form.

UNDULATING [geomorph] - (a) A landform having a wavy outline or form. (b) A rippling or scalloped land surface, having a wavy outline or appearance.

UPLAND SANDPIPER - Small wading bird (*Bartramia longicauda*) of the family Scolopacidae, mostly frequenting seashores in flocks.

VALLEY - Any low-lying land bordered by higher ground, especially an elongate, relatively large, gently sloping depression of the Earth's surface, commonly situated between two mountains or between ranges of hills and mountains, and often containing a stream or river with an outlet. It is usually developed by stream or river erosion but can be formed by faulting.

VEIN [intrus rock] - A thin, sheetlike igneous intrusion into a fissure.

WATER TABLE - The upper limit of the portion of the ground that is wholly saturated with water; the surface on which the fluid pressure in the pores of a porous medium is exactly atmospheric.

WETLANDS - Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

WILDERNESS AREA - An area unaffected by anthropogenic activities and deemed worthy of special attention to maintain its natural condition.

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## **Appendix A**

### **Resumes of Search Team**

#### **Members**

## RAYMOND G. CLARK, JR.

### EDUCATION

Completed graduate engineering courses, George Washington University, 1957  
B.S., Mechanical Engineering, University of Maryland, 1949

### SPECIALIZED TRAINING

Grad. European Command Military Assistance School, Stuttgart, 1969  
Grad. Army Psychological Warfare School, Fort Bragg, 1963  
Grad. Sanz School of Languages, D.C., 1963  
Grad. DOD Military Assistance Institute, Arlington, 1963  
Grad. Defense Procurement Management Course, Fort Lee, 1960  
Grad. Engineer Officer's Advanced Course, Fort Belvoir, 1958

### CERTIFICATIONS

Registered Professional Engineer: Kentucky (#4341); Virginia (#8303);  
Florida (#36228)

### EXPERIENCE

Thirty-one years of experience in engineering design, planning and management including construction and construction management, environmental, operations and maintenance, repair and utilities, research and development, electrical, mechanical, master planning and city management. Over six years' logistical experience including planning and programming of military assistance materiel and training for foreign countries, serving as liaison with American private industry, and directing materiel storage activities in an overseas area. Over two years' experience as an engineering instructor. Extensive experience in personnel management, cost reduction programs, and systems improvement.

### EMPLOYMENT

Dynamac Corporation (1986-present): Program Manager/Department Manager

Responsible for activities relating to Preliminary Analysis, Site Investigations, Remedial Investigations, Feasibility Studies, and Remedial Action for the Installation Restoration Program for the U.S. Air Force, Air National Guard, Bureau of Prisons, and the U.S. Coast Guard, including records search, review and evaluation of previous studies; preparation of statements of work, feasibility studies; preparation of remedial action plans, designs and specifications; review of said studies/plans to ensure that they are in conformance with requirements; review of environmental studies and reports; preparation of Air Force Installation Restoration Program Management Guidance; and preparation of Part B permits.

Howard Needles Tammen & Bergendoff (HNTB) (1981-1986): Manager

Responsible, as Project Manager, for: design of a new concourse complex at Miami International Airport to include terminal building, roadway system, aircraft apron, drainage channel relocation, satellite building with underground pedestrian tunnel, and associated underground utility corridors, to include subsurface aircraft fueling systems, with an estimated construction cost of \$163 million; a cargo vehicle tunnel under the crosswind runway with an estimated construction cost of \$15 million; design and construction of two large corporate jet aircraft hangars; and for the hydrocarbon recovery program to include investigation, analysis, design of recovery systems, monitoring of recovery systems, and planning and design of residual recovery systems utilizing biodegradation. Participated, as sub-consultant, in Air Force IRP seminar.

HNTB (1979-1981): Airport Engineer

Responsibilities included development of master plan for Iowa Air National Guard base; project initiation assistance for a new regional airport in Florida; engineering assistance for new facilities design and construction for Maryland Air National Guard; master plan for city maintenance facilities, Orlando, Florida; in-country master plan and preliminary engineering project management for Madrid, Spain, International Airport; and project management of master plan for Whiting Naval Air Station and outlying fields in Florida.

HNTB (1974-1979): Design Engineer

Responsibilities included development of feasibility and site selection studies for reliever airports in Cleveland and Atlanta; site selection and facilities requirements for the Office of Aeronautical Charting and Cartography, NOAA; and onsite mechanical and electrical engineering design for terminal improvements at Baltimore-Washington International Airport, Maryland.

HNTB (1972-1974): Airport Engineer

Responsible for development of portions of the master plan and preliminary engineering for a new international airport for Lisbon, Portugal, estimated to cost \$250 million.

Self-employed (1971-1972): Private Consultant

Responsible for engineering planning and installation of a production line for multimillion-dollar contract in Madrid, Spain, to fabricate transmissions and differentials for U.S. Army vehicles.

U.S. Army, Corps of Engineers (1969-1971): Chief, Materiel & Programs

Directed materiel planning and military training programs of military assistance to the Spanish Army. Controlled arrival and acceptance of materiel by host government. Served as liaison/advisor to American industry interested

in conducting business with Spanish government. Was Engineer Advisor to Spanish Army Construction, Armament and Combat Engineers, also the Engineer Academy and Engineer School of Application.

Corps of Engineers (1968-1969): Chief, R&D Branch, OCE

Directed office responsible to Chief of Engineers for research and development. Developed research studies in new concepts of bridging, new explosives, family of construction equipment, night vision equipment, expedient airfield surfacing, expedient aircraft fueling systems, water purification equipment and policies, prefabricated buildings, etc. Achieved Department of Army acceptance for development and testing of new floating bridge. Participated in high-level Department Committee charged with development of a Tactical Gap Crossing Capability Model.

Corps of Engineers (1967-1968): Division Engineer

Facilities engineer in Korea. Was fully responsible for management and maintenance of 96 compounds within 245 square miles including 6,000+ buildings, 1 million linear feet of electrical distribution lines, 18 water purification and distribution systems, sanitary sewage disposal systems, roads, bridges, and fire protection facilities with real property value of more than \$256 million. Planned and developed the first five-year master plan for this area. Administered \$12 million budget and \$2 million engineer supply operation. Was in responsible charge of over 500 persons. Developed and obtained approval for additional projects worth \$9 million for essential maintenance and repair. Directed cost reduction programs that produced more than \$500,000 savings to the United States in the first year.

Corps of Engineers (1963-1967): Engineer Advisor

Engineer and aviation advisor to the Spanish Army. Developed major modernization program for Spanish Army Engineers, including programming of modern engineer and mobile maintenance equipment. Directed U.S. portion of construction, testing and acceptance of six powder plants, one shell loading facility, an Engineer School of Application, and depot rebuild facilities for engineer, artillery, and armor equipment. Planned and developed organization of a helicopter battalion for the Spanish Army. Responsible for sales, delivery, assembly and testing of 12 new helicopters in country. Provided U.S. assistance to unit until self-sufficiency was achieved. Was U.S. advisor to Engineer Academy, School of Application and Polytechnic Institute.

Corps of Engineers (1960-1963): Deputy District Engineer

Responsible for planning and development of extensive construction projects in the Ohio River Basin for flood control and canalization, including dam, lock, bridge, and building construction, highway relocation, watershed studies, real estate acquisitions and dispositions. Was contracting officer for more than \$75

million of projects per year. Supervised approximately 1,300 personnel, including 300 engineers. Planned and directed cost reduction programs amounting to more than \$200,000 per year. Programmed and controlled development of a modern radio and control net in a four-state area.

Corps of Engineers (1959-1960): Area Engineer

Directed construction of a large airfield in Ohio as Contracting Officer's representative. Assured that all construction (runway, steam power plant, fuel transfer and loading facilities, utilities, buildings, etc.) complied with terms of plans and specifications. Was onsite liaison between Air Force and contractors.

Corps of Engineers (1958-1959): Chief, Supply Branch

Managed engineer supply yard containing over \$21 million construction supplies and engineer equipment. Directed in-storage maintenance, processing and deprocessing of equipment. Achieved complete survey of items on hand, a new locator system and complete rewarehousing, resulting in approximately \$159,000 savings in the first year.

Corps of Engineers (1957-1958): Student

U.S. Army Engineer School, Engineer Officer's Advanced Course.

Corps of Engineers (1954-1957): Engineer Manager

Managed engineer construction projects and was assigned to staff and faculty of the Engineer School. Was in charge of instruction on engineer equipment utilization, management and maintenance. Directed Electronic Section of the school. Coordinated preparation of five-year master plan for the Department of Mechanical and Technical Equipment.

Corps of Engineers (1949-1954): Engineer Commander

Positions of minor but increasing importance and responsibility in engineering management, communications, demolitions, construction administration and logistics.

## PROFESSIONAL AFFILIATIONS

Member, National Society of Professional Engineers  
Fellow, Society of American Military Engineers  
Member, American Society of Civil Engineers  
Member, Virginia Engineering Society  
Member, Project Management Institute

R.G. CLARK, JR.  
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HARDWARE

IBM PC

SOFTWARE

Lotus 1-2-3, D Base III Plus, Framework, Project Scheduler 5000, Harvard  
Project Manager, Volkswriter, Microsoft Project

## MARK D. JOHNSON

### EDUCATION

B.S., Geology, James Madison University, 1980

### EXPERIENCE

Eight years' technical and management experience including geologic mapping, subsurface investigations, foundation inspections, groundwater monitoring, pumping and observation well installation, geotechnical instrumentation, groundwater assessment, preparation of Air Force Installation Restoration Program Guidance, preparation of statements of work for environmental field monitoring and feasibility studies for the Air Force and the Air National Guard, development of environmental field monitoring programs, and preparation of Preliminary Assessments for the Air National Guard.

### EMPLOYMENT

#### Dynamac Corporation (1984-present): Senior Staff Scientist/Geologist

Primarily responsible for developing and managing technical support programs relevant to CERCLA related activities for the Air Force, Air National Guard, Department of Justice and Coast Guard. These activities include Statements of Work for Site Investigations (SI), Remedial Investigations (RI), and Feasibility Studies (FS); assessing groundwater at hazardous waste disposal/spill sites for the purpose of determining rates and extents of contaminant migration and for developing SI and RI programs and identifying remedial actions; reviewing SI, RI and FS contractor work plans for various government clients, developing technical and contractual requirements for SI, RI and FS projects, managing the development and preparation of Preliminary Assessments, and assisting clients in the development of their environmental management programs, which included preparation of the Air Force's Installation Restoration Program Management Guidance document.

#### Bechtel Associates Professional Corporation (1981-1984): Geologist

Performed the following duties in conjunction with major civil engineering projects including subways, nuclear power plants and buildings: prepared geologic maps of surface and subsurface facilities in rock and soil including tunnels, foundations and vaults; assessed groundwater conditions in connection with construction activities and groundwater control systems; monitored the installation of permanent and temporary dewatering systems and observation wells; monitored surface and subsurface settlement of tunnels; and participated in subsurface investigations.

#### Schnabel Engineering Associates (1981): Geologist

Inspected foundations and backfill placement.

M.D. JOHNSON  
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PROFESSIONAL CREDENTIALS

Registered Professional Geologist, South Carolina, #116, 1987

PROFESSIONAL AFFILIATIONS

Association of Engineering Geologists  
National Water Well Association/Association of Ground Water Scientists  
and Engineers

## NATASHA M. BROCK

### EDUCATION

Graduate work, civil/environmental engineering, University of Maryland,  
1987-present

Graduate work, civil/environmental engineering, University of Delaware,  
1985-1986

B.S. (cum laude), environmental science, University of the District of  
Columbia, 1984

Undergraduate work, biology, The American University, 1978-1980

### CERTIFICATION

Health & Safety Training Level C

### EXPERIENCE

Three years' experience in the environmental and hazardous waste field. Work performed includes remedial investigations/feasibility studies, RCRA facility assessments, comprehensive monitoring evaluations, and remedial facility investigations. Helped develop and test biological and chemical processes used in minimization of hazardous and sanitary waste generation. Researched multiple substrate degradation using aerobic and anaerobic organisms.

### EMPLOYMENT

Dynamac Corporation (1987-present): Environmental Scientist

In working for Dynamac's Hazardous Materials Technical Center (HMTTC), performs Preliminary Assessments, Remedial Investigations and Feasibility Studies (PA/RI/FS) under the Air National Guard Installation Restoration Program. Specifically involved in determining rates and extent of contamination, recommending groundwater monitoring procedures, and soil sampling and analysis procedures. In the process of preparing standard operating procedure manuals for quick remedial response to site spills and releases, and PA/RI/FS.

C.C. Johnson & Malhotra, P.C. (1986-1987): Environmental Scientist

Involved as part of a team in performing Remedial Investigations/Feasibility Studies (RI/FS) for EPA Regions I and IV under Resource Conservation and Recovery Act (RCRA) work assignments for REM II projects. Participated on a team involved in RCRA Facility Assessments (RFAs), Comprehensive Monitoring Evaluations (CMEs), and Remedial Facility Investigations (RFIs) for EPA work assignments under RCRA for REM III projects in Regions I and IV. Work included solo oversight observations of field sampling and facility inspections. Additional responsibilities included promotion work, graphic layout, data entry-quality check for various projects. Certified Health & Safety Training Level C.

Work Force Temporary Services (1985-1986): Research Scientist

In working for DuPont's Engineering Test Center, helped in the development and testing of laboratory-scale biological and chemical processes for a division whose main purpose was to reduce the amount of hazardous waste generated. Also worked for Hercules, Inc., with a group involved in polymer use for wastewater treatment for clients in various industrial fields. Specifically involved in product consultation, troubleshooting, and product development.

National Oceanic and Atmospheric Administration (1982-1984): Research Assistant

Involved with an information gathering and distribution center of weather impacts worldwide. Specifically involved in data collection, distribution of data to clients, assessment production and special reports.

## BETSY A. BRIGGS

### EDUCATION

B.S., Biology and Chemistry, State University College of New York at Cortland, 1979

Completed several courses in M.B.A. program, University of Phoenix, Denver, Colorado Division, 1984

### SPECIALIZED TRAINING

Hazardous Waste Management course, Air Force Institute of Technology, 1986

### CERTIFICATION

Certified Hazardous Materials Manager, Institute of Hazardous Materials Management, 1985

### SECURITY CLEARANCE

Secret/DOE

### EXPERIENCE

Nine years of experience including three years in hazardous waste management, two years as an environmental engineer, two years as an ecologist, and two years in laboratory research. Has conducted ambient air quality monitoring programs, critical pathways projects to study movement of radioactive materials in the environment, metallurgic laboratory analyses, and independent studies in biology and chemistry. Currently provides managerial oversight and technical support to a hazardous waste program for the Air Force.

### EMPLOYMENT

Dynamac Corporation (1985-present): Program Manager/Hazardous Waste Specialist

Primary responsibility as program manager is to oversee and manage up to 44 field personnel involved in RCRA and CERCLA work in support of the U.S. Air Force. Other duties include performing preliminary assessments/site surveys for the Air National Guard, marketing and proposal preparation, and preparing and providing training in preparation for the Certified Hazardous Materials Manager examination.

As hazardous waste specialist the primary responsibility was to manage the hazardous waste program at Myrtle Beach Air Force Base. Duties included:

- o Reviewing the design and specifications of various base construction projects and overseeing such projects to ensure compliance with all applicable state and federal hazardous waste regulations. Projects under design included a corrosion control facility, TSD facility, two accumulation points, and a parts cleaning vat system. Construction project oversight included the final inspection of the entomology building to ensure that the facility was equipped for proper storage, usage and disposal of pesticides; removal of materials contaminated with pesticides, PCBs, petroleum products, and solvents from six sites; asbestos removal and disposal from a former hangar site; and the removal of two underground storage tanks, one of which was leaking.
- o Conducting surveys of hazardous waste generating activities.
- o Advising on need for and methods of minimizing hazardous waste generation.
- o Writing and maintaining hazardous waste management plan.
- o Preparing hazardous waste management reports and documents required by state and federal law.
- o Maintaining liaison with federal and state regulatory agencies on matters involving criteria, standards, performance specifications, and monitoring.
- o Providing information and technical consultation to Air Force installation staff regarding hazardous materials and hazardous waste operations.
- o Serving as ad hoc advisor to environmental contingency response teams.

Rockwell International (1982-1984): Environmental Engineer

Primary responsibility was collection, evaluation, and reporting of ambient air monitoring data. Other responsibilities included technical assistance for monitoring total suspended solids in ambient air. Also performed data collection and reduction of air effluent emission control activities.

Environmental monitoring and control programs are to ensure that all Department of Energy and other governmental effluent regulations are met, and that plant effluents are consistent with the As Low As Reasonably Achievable (ALARA) Principle. Monthly and Annual Reports summarize the effluent and environmental monitoring programs.

Rockwell International (1980-1982): Ecologist

Responsible for planning, organizing, and leading critical pathways projects designed to study the movement of radioactive materials throughout the environment. Projects were: (1) general critical pathway evaluation to identify

sampling points possibly not considered in present monitoring program; (2) plant uptake versus plant uptake plus foliar deposition measurement study; (3) deer tissue analysis program; and (4) food stuff monitoring program. Progress and results were published in semiannual reports.

Colorado School of Mines Research Institute, Texas Gulf Research Laboratory (1979-1980): Senior Laboratory Technician

Work involved quantitative analysis of platinum, palladium, and silver in soil samples. Analysis included sample preparation, fire assays, calorimetric procedures, and smelt tests.

State University College of New York at Cortland (1978-1979): Undergraduate Independent Study

Project involved the isolation of trail pheromone from spun silk of *Hyphantria* (fall webworm). Included organic and inorganic extraction procedures and performing bioassays. Also worked on production of synthetic diet comparable to fresh leaf diet for *Malacosoma* (eastern tent caterpillar).

#### PUBLICATIONS

Hazardous Waste Management Survey for Myrtle Beach Air Force Base, Hazardous Materials Technical Center, Rockville, Maryland, 1986 and 1988.

Hazardous Waste Management Plan for Myrtle Beach Air Force Base, Hazardous Materials Technical Center, Rockville, Maryland, 1987 and 1988.

Waste Minimization Guidance for Myrtle Beach Air Force Base, Hazardous Materials Technical Center, Rockville, Maryland, 1988.

Underground Storage Tank Management Plan for Myrtle Beach Air Force Base, Hazardous Materials Technical Center, Rockville, Maryland, 1988.

Annual Environmental Monitoring Report, Rockwell International, Energy Systems Group, Rocky Flats Plant, 1982 and 1983.

Environmental Studies Group Semiannual Report, Rockwell International, Energy Systems Group, Rocky Flats Plant, June/December of 1980 and 1981.

#### TECHNICAL PRESENTATIONS

PCB Management, Myrtle Beach Air Force Base, 1987.

Underground Storage Tank Regulations/History, Myrtle Beach Air Force Base, 1986.

Overview of the Hazardous Waste Training Program, Myrtle Beach Air Force Base, 1985.

Overview of the Environmental Studies Group, Nevada Test Site and Rockwell International at Hanford, Washington, 1981.

ANDY J. PETERS, JR.

EDUCATION

B.S., chemistry, Tulane University, 1977

EPA course: Personnel Protection and Safety

U.S. Army courses: Technical Escort course, Nuclear Emergency Team  
Operations course

EXPERIENCE

Seven years' experience in hazardous material and waste management. Most recent experience in solving hazardous material and waste management problems for Department of Defense agencies. Six years of military experience in supervising, directing, managing, and planning the transportation, storage, and disposal of chemical and conventional ammunition, explosives, and hazardous material and waste. Knowledgeable of federal DOT and OSHA regulations on hazardous material. Familiar with federal environmental regulations.

EMPLOYMENT

Dynamac Corporation (1985-present): Staff Scientist

Responsibilities within the Hazardous Materials Operation Department. Performs audits on hazardous material and waste operations. Plans and prepares technical reports concerning personal protection, health and safety, transportation, storage, and disposal of hazardous materials and wastes. Prepares and reviews technical proposals dealing with these areas of expertise. Prepares statements of work as part of the U.S. Air Force Installation Restoration Program.

Conducted a study for the Department of Defense concerned with improving military response to accidents involving DOD shipments of explosives, munitions, and hazardous material. Assisted in the preparation of the final drafts of DOD Instruction 4145.19 and DLA Manual 4145.11 governing the storage and handling of hazardous material. Prepared statements of work for Phase IV-A Remedial Action Plans for Minneapolis-St. Paul Air Force Reserve Base and Delaware Air National Guard Base.

U.S. Army Technical Escort Unit (1984-1985): Special Assistant to the Commander

Supervised 21 personnel in the demilitarization of leaking chemical munitions utilizing a mobile demilitarization system. Directed daily operations. Supervised health and safety activities to include personnel and equipment decontamination, adherence to operating procedures, and operation of protective systems and equipment. Directed and supervised system maintenance and supply. Planned monthly work schedules. Supervised all aspects of personnel assignment, training, and administration.

U.S. Army Technical Escort Unit (1983-1984): Operations Officer

Supervised the U.S. and overseas movement of all Department of Defense military chemical agents. Managed and directed the demilitarization or emergency disposal of leaking chemical munitions and material. Deployed and maintained the readiness of the DOD emergency response team tasked to respond worldwide to a military chemical accident. Planned unit mobilization for the deployment of chemical munitions.

U.S. Army Technical Escort Unit (1982-1983): Intelligence Officer

Monitored and supervised all aspects of unit safety, security, and chemical surety. Supervised the storage and transportation of unit ammunition and explosives. Monitored the U.S. and overseas movement of all DOD military chemical agents. Supervised the maintenance of unit radiation records and detection equipment. Developed a unit respiratory protection program. Supervised preparation for all unit safety, security, and surety inspections.

U.S. Army Technical Escort Unit (1980-1982): Chief, Escort and Disposal Team

Supervised the transportation and emergency disposal of military chemical agents, munitions, and other hazardous materials. Planned and supervised the relocation of war reserve stocks of Navy Chemical munitions to include training, logistical management, communications, security, and public relations. Responsible for the welfare, training, and supervision of 30 personnel.

U.S. Army Field Artillery Training Center (1979-1980): Ammunition Officer

Supervised, directed, and managed the pickup, delivery, and return of small arms and artillery ammunition, pyrotechnics and explosives. Developed and implemented a vehicle maintenance program, an ammunition accounting system, and a safety awareness program. Responsible for the welfare, training, and supervision of 30 personnel.



## **Appendix B**

### **Outside Agency**

#### **Contact List**

## OUTSIDE AGENCY CONTACT LIST

Department of Natural Resources  
Fresh Water Wetlands Section  
291 Promenade St.  
Providence, RI 02908  
(401) 277-6820

National Oceanic and Atmospheric Administration  
6010 Executive Blvd.  
Rockville, MD 20852  
(301) 443-8910

North Kingstown Water Commission  
80 Foston Neck Road  
North Kingstown, RI 02852  
(401) 294-3331

Rhode Island Department of Environmental Management  
Division of Planning & Development  
Natural Heritage Program  
22 Hayes Street, Room 122  
Providence, RI 02908  
Christopher Raithel  
(401) 277-2776

United States Department of Agriculture  
Soil Conservation Service  
4046 Quaker Lane  
West Warwick, RI 02893  
(401) 828-1300

United States Geological Survey  
12201 Sunrise Valley Drive  
Reston, VA 22092  
Library  
(703) 648-4000

United States Geological Survey  
237 J.O. Pastore Federal Building  
Providence, RI 02903

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## **Appendix C**

# **USAF Hazard Assessment Rating Methodology**

## **USAF HAZARD ASSESSMENT RATING METHODOLOGY**

The Department of Defense (DoD) has developed a comprehensive program to identify, evaluate, and control hazardous waste disposal practices associated with past waste disposal techniques at DoD facilities. One of the actions required under this program is to:

Develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts (Reference: DEQPPM 81-5, December 11, 1981).

Accordingly, the U.S. Air Force has sought to establish a system to set priorities for taking further action at sites based upon information gathered during the Preliminary Assessment phase of the Installation Restoration Program.

### **PURPOSE**

The purpose of the site rating model is to assign a ranking to each site where there is suspected contamination from hazardous substances. This model will assist the Air National Guard in setting priorities for follow-up site investigations.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous waste present in sufficient quantity), and (2) potential for migration exists. A site may be deleted from ranking consideration on either basis.

### **DESCRIPTION OF THE MODEL**

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DoD needs.

The model uses data readily obtained during the Preliminary Assessment portion of the IRP. Scoring judgment and computations are easily made. In assessing

the hazards at a given site, the model develops a score based on the most likely routes of contamination and worst hazards at the site. Sites are given low scores only if there are clearly no hazards. This approach meshes well with the policy for evaluating and setting restrictions on excess DoD properties.

Site scores are developed using the appropriate ranking factors presented in this appendix. The site rating form and the rating factor guidelines are provided at the end of this appendix.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: (1) possible receptors of the contamination, (2) the waste and its characteristics, (3) the potential pathways for contaminant migration, and (4) any effort that was made to contain the waste resulting from a spill.

The receptors category rating is based on four rating factors: (1) the potential for human exposure to the site, (2) the potential for human ingestion of contaminants should underlying aquifers be polluted, (3) the current and anticipated use of the surrounding area, and (4) the potential for adverse effects upon important biological resources and fragile natural settings. The potential for human exposure is evaluated on the basis of the total population within 1000 feet of the site, and the distance between the site and the base boundary. The potential for human ingestion of contaminants is based on the distance between the site and the nearest well, the groundwater use of the uppermost aquifer, and population served by the groundwater supply within 3 miles of the site. The uses of the surrounding area are determined by the zoning within a 1-mile radius. Determination of whether or not critical environments exist within a 1-mile radius of the site predicts the potential for adverse effects from the site upon important biological resources and fragile natural settings. Each rating factor is numerically evaluated (0-3) and increased by a multiplier. The maximum possible score is also computed. The factor score and maximum possible scores are totaled, and the receptors subscore computed as follows:

$$\text{receptors subscore} = (100 \times \text{factor subtotal} / \text{maximum score subtotal}).$$

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst

case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score while scores for solids are reduced.

The pathways category rating is based on evidence of contaminant migration along one of three pathways: surface water migration, flooding, and groundwater migration. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned, and for direct evidence, 100 points are assigned. If no evidence is found, the highest score among the three possible routes is used. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The scores for each of the three categories are added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Scores for sites with no containment are not reduced. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well-managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the score for the other three categories.

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### III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists, then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: Surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

#### 1. Surface water migration

Distance to nearest surface water		8		24
Net precipitation		6		18
Surface erosion		8		24
Surface permeability		6		18
Rainfall intensity		8		24

Subtotals  108

Subscore (100 x factor score subtotal/maximum score subtotal)

#### 2. Flooding

		1		3
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Subscore (100 x factor score/3)

#### 3. Groundwater migration

Depth to groundwater		8		24
Net precipitation		6		18
Soil permeability		8		24
Subsurface flows		8		24
Direct access to groundwater		8		24

Subtotals  114

Subscore (100 x factor score subtotal/maximum score subtotal)

#### C. Highest pathway score

Enter the highest subscore value from A, B-1, B-2, or B-3 above

Pathways subscore

### IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors  
Waste Characteristics  
Pathways

Total  divided by 3 =

Gross Total Score

B. Apply factor for waste containment from waste management practices.

Gross Total Score x Waste Management Practices Factor = Final Score

x  =

# HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

## 1. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels				Multiplier
	0	1	2	3	
A. Population within 1,000 feet (includes on-base facilities)	0	1-25	26-100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land use/zoning (within 1-mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or Industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1-mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use	Recreation, propagation and management of fish and wildlife	Shellfish propagation and harvesting	Potable water supplies	6
G. Groundwater use of uppermost aquifer	Not used, other sources readily available	Commercial Industrial, or irrigation, very limited other water sources	Drinking water, municipal water available	Drinking water, no municipal water available, commercial, industrial, or irrigation; no other water source available	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1-50	51-1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1-50	51-1,000	Greater than 1,000	6

## II. WASTE CHARACTERISTICS

### A-1 Hazardous Waste Quantity

- S = Small quantity (5 tons or 20 drums of liquid)  
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)  
L = Large quantity (20 tons or 85 drums of liquid)

### A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records
  - o Knowledge of types and quantities of wastes generated by shops and other areas on base
- S = Suspected confidence level
- o No verbal reports or conflicting verbal reports and no written information from the records
  - o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site

### A-3 Hazard Rating

Rating Factors	Rating Scale Levels		
	0	1	2
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels
			Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability, and radioactivity and determine the hazard rating.

### Hazard Rating      Points

- High (H)      3  
Medium (H)      2  
Low (L)      1

# II. WASTE CHARACTERISTICS--Continued

## Waste Characteristics Matrix

<u>Point Rating</u>	<u>Hazardous Waste Quantity</u>	<u>Confidence Level of Information</u>	<u>Hazard Rating</u>
100	L	C	H
	L	C	H
80	H	C	H
70	L	S	H
	S	C	H
60	H	C	H
	L	S	H
50	L	C	L
	H	S	H
	S	C	H
40	H	C	L
	L	S	L
30	S	C	L
	H	S	L
20	S	S	L

### Notes:

For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

#### Confidence Level

- o Confirmed confidence levels (C) can be added.
- o Suspected confidence levels (S) can be added.
- o Confirmed confidence levels cannot be added with suspected confidence levels.

#### Waste Hazard Rating

- o Wastes with the same hazard rating can be added.
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., HCH + SCH = LCH if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an HCH designation (60 points). By adding the quantities of each waste, the designation may change to LCH (80 points). In this case, the correct point rating for the waste is 80.

## B. Persistence Multiplier for Point Rating

### Multiply Point Rating Persistence Criteria

Metals, polycyclic compounds, and halogenated hydrocarbons substituted and other ring compounds  
Straight chain hydrocarbons  
Easily biodegradable compounds

From Part A by the following

1.0  
0.9  
0.8  
0.4

## C. Physical State Multiplier

### Physical state

Liquid  
Sludge  
Solid

Multiply Point Total from Parts A and B by the following

1.0  
0.75  
0.50

### III. PATHWAYS CATEGORY

#### A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, groundwater, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

#### B-1 Potential for Surface Water Contamination

Rating Factors	Multiplier		
	0	1	2
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to a mile	501 feet to 2,000 feet
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches
Surface erosion	None	Slight	Moderate
Surface permeability	0% to 15% clay (>10 <sup>-2</sup> cm/sec)	15% to 30% clay (10 <sup>-2</sup> to 10 <sup>-4</sup> cm/sec)	30% to 50% clay (10 <sup>-4</sup> to 10 <sup>-6</sup> cm/sec)
Rainfall intensity based on 1-year, 24 hour rainfall (thunderstorms)	<1.0 Inch 0-5 0	1.0 to 2.0 Inches 6-35 30	2.1 to 3.0 inches 36-49 60
			>3.0 inches >50 100

#### B-2 Potential for Flooding

Floodplain	Beyond 100-year floodplain	In 100-year floodplain	In 10-year floodplain	Floods annually	1
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#### B-3 Potential for Groundwater Contamination

Depth to groundwater	Greater than 500 feet	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Soil permeability	Greater than 50% clay (>10 <sup>-6</sup> cm/sec)	30% to 50% clay (10 <sup>-4</sup> to 10 <sup>-6</sup> cm/sec)	15% to 30% clay 10 <sup>-2</sup> to 10 <sup>-4</sup> cm/sec	0% to 15% clay (<10 <sup>-2</sup> cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high groundwater level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean groundwater level	8
Direct access to groundwater (through faults, fractures, faulty well casings, subsidence, fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. Waste Management Practices Factor

The following multipliers are then applied to the total risk points (from A):

<u>Waste Management Practice</u>	<u>Multiplier</u>
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Fire Protection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1, or III-B-3, then leave blank for calculation of factor score and maximum possible score.

## **Appendix D**

### **Site Hazard Assessment Rating Forms and Factor Rating Criteria**

Site Hazard Assessment Rating Forms  
and Factor Rating Criteria are not  
included since no sites were found.

**Appendix E**

**Underground Storage**

**Tank Inventory**

Underground Storage Tank and Oil/Water Separator Inventory  
143rd TAG, Rhode Island Air National Guard  
Quonset State Airport, Rhode Island

Location	Bldg P-2	Bldg P-3-1	Bldg P-3-2	Bldg P-3-4	Bldg P-3-3	Bldg P-3-5	Bldg P-3-6
Capacity (gallons)	10,000	1,000	2,000	5,000	5,000	5,000	N/A
Contents	Fuel oil	Waste oil	Diesel fuel	MOGAS	Fuel oil	MOGAS	Gasoline interceptor
Year Installed	1980	1980	1980	1980	1980	1980	1980
Material of Construction	Steel-welded	Steel-welded	Steel-welded	Steel-welded	Steel-welded	Steel-welded	Concrete
Coatings							
A. Interior	A. unknown	A. unknown	A. epoxy	A. epoxy	A. epoxy	A. epoxy	A. epoxy
B. Exterior	B. unknown	B. bitumen	B. amine cured coal tar epoxy	B. amine cured coal tar epoxy	B. amine cured coal tar epoxy	B. amine cured coal tar epoxy	B. uncoated
Cathodic Protection	None	None	Sacrificial anode	Sacrificial anode	Sacrificial anode	Sacrificial anode	None
Status of Tank (Year abandoned)	Active	Active	Active	Active	Active	Active	Active
Latest Inspection Date	None	None	None	None	None	None	None
Secondary Containment	None	None	Double wall	Double wall	Double wall	Double wall	None

# Underground Storage Tank and Oil/Water Separator Inventory 143rd TAG, Rhode Island Air National Guard Quonset State Airport, Rhode Island

Location	Bldg P-4	Bldg P-5	Bldg P-7	Bldg P-8-1	Bldg P-8-2	Bldg P-8-3	Bldg P-8-4
Capacity (gallons)	2,500	4,000	6,000	5,050	12,000	2,000	2,000
Contents	Fuel oil	Fuel oil	Fuel oil	Waste oil	Fuel oil	Detergents	Sediment tank for 5,050 gal. waste oil storage tank
Year Installed	1980	1980	1981	1981	1981	1981	1981
Material of Construction	Steel-welded	Steel-welded	Steel-welded	Steel-welded	Steel-welded	Fiberglass	Steel-welded
Coatings							
A. Interior	A. unknown	A. unknown	A. epoxy	A. unknown	A. unknown	A. uncoated	A. unknown
B. Exterior	B. bitumen	B. bitumen	B. amine cured coal tar epoxy	B. bitumen	B. bitumen	B. uncoated	B. bitumen
Cathodic Protection	None	None	Sacrificial anode	Sacrificial anode	None	None	Sacrificial anode
Status of Tank (Year abandoned)	Active	Active	Active	Active	Active	Active	Active
Latest Inspection Date	None	None	None	None	None	None	None
Secondary Containment	None	None	Concrete vault	Double wall	None	None	None

Underground Storage Tank and Oil/Water Separator Inventory  
143rd TAG, Rhode Island Air National Guard  
Quonset State Airport, Rhode Island

Location	Bldg P-8-5	Bldg P-9-1	Bldg P-9-2	Bldg P-13-1	Bldg P-13-2	Bldg P-11
Capacity (gallons)	200 gpm	N/A	1,000	12,000	10,000	5,000
Contents	Oil inter-ceptor pump-ing pits	Gasoline interceptor	Fuel oil	Fuel oil	Fuel oil	Fuel oil
Year Installed	1981	1981	1980	1981	1981	1981
Material of Construction	Steel-welded	Concrete	Steel-welded	Steel-welded	Steel-welded	Steel-welded
Coatings						
A. Interior	A. unknown	A. uncoated	A. uncoated	A. epoxy	A. epoxy	A. unknown
B. Exterior	B. bitumen	B. uncoated	B. amine cured coal tar epoxy	B. amine cured coal tar epoxy	B. amine cured coal tar epoxy	B. bitumen
Cathodic Protection	None	None	Sacrificial anode	Sacrificial anode	None	None
Status of Tank (Year abandoned)	Active	Active	Active	Active	Active	Active
Latest Inspection Date	None	None	None	None	None	None
Secondary Containment	Concrete vault	None	Double wall	Double wall	Double wall	None

## **Appendix F**

### **Soil Borings**

<b>GOLDBERG-ZOINO &amp; ASSOCIATES, INC</b> 140 BROADWAY, PROVIDENCE, RHODE ISLAND GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS		<b>PROJECT</b> Air National Guard Quonset Point, R.I.		<b>REPORT OF BORING No. <u>B-1</u></b> SHEET <u>1</u> OF <u>1</u> FILE No. <u>Y-30033</u> CHKD BY: <u>ARU</u>																																			
BORING Co. <u>Guild Drilling Co.</u> FOREMAN <u>Mike McDonald</u> GZA ENGINEER <u>Steve Simpson</u>		BORING LOCATION <u>Ere Exploration Location Plan</u> GROUND SURFACE ELEVATION _____ DATUM _____ DATE START <u>6-11-87</u> DATE END <u>6-11-87</u>																																					
SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A MOD. HAMMER FALLING 30 IN. CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB HAMMER FALLING 24 IN.		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="5">GROUNDWATER READINGS</th> </tr> <tr> <th>DATE</th> <th>TIME</th> <th>WV</th> <th>CON</th> <th>STABILIZATION TIME</th> </tr> <tr> <td>6-11-87</td> <td>11:30</td> <td>7.2</td> <td>10.0'</td> <td>drilling</td> </tr> <tr> <td>6-11-87</td> <td>12:30</td> <td>8.7</td> <td>15.0'</td> <td>drilling</td> </tr> </table>				GROUNDWATER READINGS					DATE	TIME	WV	CON	STABILIZATION TIME	6-11-87	11:30	7.2	10.0'	drilling	6-11-87	12:30	8.7	15.0'	drilling														
GROUNDWATER READINGS																																							
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6-11-87	11:30	7.2	10.0'	drilling																																			
6-11-87	12:30	8.7	15.0'	drilling																																			
CASING SIZE: _____ OTHER: <u>3 3/4" R.S.A.</u>																																							
DEPTH (ft)	CASING (ft)	No.	PEN. (in)	DEPTH (ft)	BLOWS/ft	SAMPLE DESCRIPTION <small>Burmister (USCS) CLASSIFICATION</small>	STRATUM DESCRIPTION																																
0		C-1A	27/9.5	0-1.0	Cored	Cored 8-inch concrete pavement	1. CONCRETE																																
		S-1	24/12	1.0-3.0	14-23-25-23	Dense, yellow-brown, coarse to fine SAND, some(-) fine Gravel, trace(+) Silt changing at 1.3 feet to medium to fine SAND, trace(+) Silt (SM-SM to SP-SM)	2. 0.7'± 3. 1.3'± 4. GRAVELLY SAND																																
		S-2	24/12	3.0-5.0	10-20-42-38	Very dense, gray-brown, fine SAND, trace(+) Silt, trace fine Gravel (SP-SM)	5. SILTY SANDY FILL																																
5		S-3	24/18	5.0-7.0	1-2-3-3	Loose, gray, medium to fine(+) SAND, little Silt, little organic fibers (SM)	5'±																																
		S-4	24/24	7.0-9.0	2-7-8-15	Medium dense, gray to brown, medium to fine(+) SAND, little Silt, little organic fibers (SM)	SILTY FIBROUS SAND																																
10		S-5	24/24	10.0-12.0	5-9-9-12	Medium dense, brown to gray, medium to fine SAND, trace(+) Silt, trace organic fibers (SP-SM)																																	
		S-6	24/18	15.0-17.0	8-9-17-27	Medium dense, brown to gray, medium to fine(+) SAND, trace(+) Silt, trace organic fibers (SP-SM)																																	
15						Bottom of Boring at 17 feet																																	
		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="2">GRANULAR SOILS</th> <th colspan="2">COHESIVE SOILS</th> </tr> <tr> <th>BLOWS/FT</th> <th>DENSITY</th> <th>BLOWS/FT</th> <th>DENSITY</th> </tr> <tr> <td>0-4</td> <td>V LOOSE</td> <td>&lt;2</td> <td>V SOFT</td> </tr> <tr> <td>4-10</td> <td>LOOSE</td> <td>2-4</td> <td>SOFT</td> </tr> <tr> <td>10-30</td> <td>M DENSE</td> <td>4-8</td> <td>M STIFF</td> </tr> <tr> <td>30-50</td> <td>DENSE</td> <td>8-15</td> <td>STIFF</td> </tr> <tr> <td>&gt;50</td> <td>V DENSE</td> <td>15-30</td> <td>V STIFF</td> </tr> <tr> <td></td> <td></td> <td>&gt;30</td> <td>HARD</td> </tr> </table>		GRANULAR SOILS		COHESIVE SOILS		BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	0-4	V LOOSE	<2	V SOFT	4-10	LOOSE	2-4	SOFT	10-30	M DENSE	4-8	M STIFF	30-50	DENSE	8-15	STIFF	>50	V DENSE	15-30	V STIFF			>30	HARD	REMARKS: 1. Bit weight 100 lbs(±), time/core 5-20 min.(±), C-1A: 2 3/4" inside diameter (I.D.). C-1A: 7 5/8" I.D.±. 2. Water used to aid in drilling cores. 3. 3"(±) of bottom of 2 3/4" I.D. core broke in core sampler. 4. Duplicate samples taken when available. 5. Broken gravel observed in sample. 6. Hole backfilled with drilled soil and surface cemented.			
GRANULAR SOILS		COHESIVE SOILS																																					
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY																																				
0-4	V LOOSE	<2	V SOFT																																				
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		>30	HARD																																				
		NOTES: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING. LOCAL FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.																																					

BORING NO. B-1

GOLDBERG-ZOINO & ASSOCIATES INC  
140 BROADWAY, PROVIDENCE, RHODE ISLAND  
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT

Air National Guard  
Dugway Point, B-1

REPORT OF BORING NO. B-2

SHEET 1 OF 1  
FILE NO. Y-30033  
CHKD BY: ABU

BORING Co. Guild Drilling Co.  
FOREMAN Mike McDonald  
GZA ENGINEER Tony Urbani

BORING LOCATION See Exploration Location Plan  
GROUND SURFACE ELEVATION DATUM  
DATE START 6-12-87 DATE END 6-12-87

SAMPLER UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A  
140 lb HAMMER FALLING 30 in  
CASING UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb HAMMER FALLING 24 in

GROUNDWATER READINGS

DATE	TIME	WATER	TEMP	STABILIZATION TIME

CASING SIZE: OTHER: 3 3/4" N.E.A.

DEPTH (ft)	CASING (in)	SAMPLE				SAMPLE DESCRIPTION BURNISTON (USCS) CLASSIFICATION	STRATUM DESCRIPTION
		No	IN	DEPTH (ft)	BLOWS/ft		
0		E-1	13/13	0-1.1		Concrete Core	1. CONCRETE
		S-1	24/18	1.0-3.0	4-10-11-25	Medium dense, brown, coarse to fine SAND, little fine Gravel, trace(+) Silt changing at 1.5 feet to brown-gray, medium to fine SAND, trace Silt, (SP-SM to SP)	2. 1.1'± 3. 1.5'± GRAVELLY SAND
		S-2	24/18	3.0-5.0	16-15-25-30	Dense, gray, fine SAND, trace(+) Silt (SP-SM)	SANDY FILL
5		S-3	24/18	5.0-7.0	3-5-7-8	Medium dense, gray, stratified fine SAND, trace(+) Silt with fine to medium SAND, trace(+) Silt (SP-SM)	5'± STRATIFIED SANDS
10		S-4	24/18	10.0-12.0	5-2-3-10	Medium, loose, gray stratified fine SAND, trace(+) Silt with fine to medium SAND, trace(+) Silt (SP-SM)	
15		S-5	24/18	15.0-17.0	3-4-6-11	Medium dense, gray, fine SAND, little Silt (SM)	
						Bottom of Boring at 17 feet	

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/ft	DENSITY	BLOWS/ft	DENSITY
0-4	V LOOSE	<2	V SOFT
4-10	LOOSE	2-4	SOFT
10-30	M DENSE	4-8	M STIFF
30-50	DENSE	8-15	STIFF
>50	V DENSE	>15	V STIFF
			HARD

REMARKS

1. Bit weight 100 psi (1), time/cure 5-10 min (1).
2. Water used to aid in drilling concrete cores.
3. Duplicate samples taken when available.
4. Installed well: 1 1/2" PVC screening from 15'(1) - 5'(1) below ground surface, 1 1/2" PVC riser from 5'(1) to ground surface, annular space filled with filter sand, 1'(1) bentonite seal, riser installed and cemented into place.



NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.  
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING NO. B-2

BORING NO. B-2

<b>GOLDBERG-ZOINO &amp; ASSOCIATES, INC.</b> 140 BROADWAY, PROVIDENCE, RHODE ISLAND <b>GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS</b>		<b>PROJECT</b> <u>Air National Guard</u> <u>Dugout Point, R.I.</u>		<b>REPORT OF BORING No.</b> <u>B-3</u> <b>SHEET</b> <u>1</u> <b>OF</b> <u>1</u> <b>FILE No.</b> <u>Y-30033</u> <b>CHKD BY</b> <u>ABU</u>																																	
<b>BORING Co.</b> <u>Grill &amp; Grilling Co.</u> <b>FOREMAN</b> <u>Darvil Green</u> <b>GZA ENGINEER</b> <u>Steve Simpson</u>		<b>BORING LOCATION</b> <u>See Exploration Location Plan</u> <b>GROUND SURFACE ELEVATION</b> <u>        </u> <b>DATUM</b> <u>        </u> <b>DATE START</b> <u>6-8-87</u> <b>DATE END</b> <u>6-8-87</u>																																			
<b>SAMPLER</b> <u>UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A</u> <u>MOB HAMMER FALLING 30"</u> <b>CASING</b> <u>UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300# HAMMER FALLING 24"</u>		<b>GROUNDWATER READINGS</b>																																			
		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>DATE</th> <th>TIME</th> <th>WY</th> <th>TEMP</th> <th>STABILIZATION TIME</th> </tr> <tr> <td>6-8-87</td> <td>13:30</td> <td>N.A.</td> <td></td> <td>Drilling</td> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>				DATE	TIME	WY	TEMP	STABILIZATION TIME	6-8-87	13:30	N.A.		Drilling																						
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6-8-87	13:30	N.A.		Drilling																																	
<b>CASING SIZE:</b> <u>        </u> <b>OTHER:</b> <u>2 1/4" R.E.A.</u>																																					
DEPTH (ft)	CASING (in/ft)	No	PEN (in)	DEPTH (ft)	BLOWS/FT	SAMPLE DESCRIPTION <u>DESCRIPTION (USCS)</u> <u>CLASSIFICATION</u>	STRATUM DESCRIPTION																														
0		C-1A	12/10	0-1.0		Concrete Core	1. CONCRETE																														
		S-1	24/16	1.0-3.0	13-25-25-24	Dense, gray-brown, fine to coarse SAND, trace Silt, trace Gravel (SP)	0.8'±																														
		S-2	24/14	3.0-5.0	11-13-15-13	Medium dense, gray-brown, fine to coarse SAND, trace Silt, trace Gravel (SP)	2. GRAVELLY SANDY FILL																														
5		S-3	24/15	5.0-7.0	4-5-1-1	Loose, gray-brown, fine to coarse SAND, trace Silt, trace Gravel changing at 6.5 feet to fine SAND, little Silt (SP to SM)	6.5'±																														
		S-4	24/12	7.0-9.0	WOR 1-1-3	Very loose, fine to coarse SAND, trace Silt; fine SAND, little Silt - stratified (organic odor) (SP to SM)	SANDS AND SILTY SANDS																														
10		S-5	24/16	10.0-12.0	1-1-1-1	Very loose, dark gray, fine to coarse SAND, trace Silt changing at 10.5 feet to fibrous PEAT, trace fine Sand (SP to PT)	10.5'±																														
		S-6	24/12	12.0-14.0	2-1-7-8	Loose, gray-brown, fine SAND, little Silt, trace organic fibers (SM)	12'±																														
15		S-7	24/18	15.0-17.0	2-10-14-17	Medium dense, gray, fine SAND, little Silt (SM)	SILTY SANDS																														
						Bottom of Boring at 17 feet	4. 5. 6.																														
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="2">GRANULAR SOILS</th> <th colspan="2">COHESIVE SOILS</th> </tr> <tr> <th>BLOWS/FT</th> <th>DENSITY</th> <th>BLOWS/FT</th> <th>DENSITY</th> </tr> <tr> <td>0-4</td> <td>V LOOSE</td> <td>0-2</td> <td>V SOFT</td> </tr> <tr> <td>4-10</td> <td>LOOSE</td> <td>2-4</td> <td>SOFT</td> </tr> <tr> <td>10-30</td> <td>M DENSE</td> <td>4-8</td> <td>M STIFF</td> </tr> <tr> <td>30-50</td> <td>DENSE</td> <td>8-15</td> <td>STIFF</td> </tr> <tr> <td>&gt;50</td> <td>V DENSE</td> <td>15-30</td> <td>V STIFF</td> </tr> <tr> <td></td> <td></td> <td>&gt;30</td> <td>HARD</td> </tr> </table>		GRANULAR SOILS		COHESIVE SOILS		BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	0-4	V LOOSE	0-2	V SOFT	4-10	LOOSE	2-4	SOFT	10-30	M DENSE	4-8	M STIFF	30-50	DENSE	8-15	STIFF	>50	V DENSE	15-30	V STIFF			>30	HARD	<b>REMARKS:</b> <ol style="list-style-type: none"> <li>1. Bit weight 100 psi (sl), time/core 5 min(sl), B-3: 2 3/4" s.d. (inside diameter), B-1A: 4 5/8" s.d.</li> <li>2. Made use of water to drill through concrete.</li> <li>3. Duplicate samples taken when available.</li> <li>4. Did not appear to encounter groundwater.</li> <li>5. Bottom of boring at 17'.</li> <li>6. Borehole filled with drilled soil and top of hole cemented.</li> </ol>			
GRANULAR SOILS		COHESIVE SOILS																																			
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY																																		
0-4	V LOOSE	0-2	V SOFT																																		
4-10	LOOSE	2-4	SOFT																																		
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1) THE STRATIFICATION LINE REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT THE S AND UNDER CONDITIONS STATED ON THE BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.																																					
							<b>BORING No.</b> <u>B-3</u>																														

## BORING NO. B-3

GOLDBERG ZOINO & ASSOCIATES, INC.  
140 BROADWAY, PROVIDENCE, RHODE ISLAND  
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT  
Air National Guard  
Quonset Point, P.I.

REPORT OF BORING No. B-4  
SHEET 1 OF 2  
FILE No. Y-30033  
CHKD BY APU

BORING Co. Guido Drilling Co.  
FOREMAN Mike McDonald  
GZA ENGINEER Steve Simpson

BORING LOCATION See Exploration Location Plan  
GROUND SURFACE ELEVATION                      DATUM                       
DATE START 6-11-87 DATE END 6-12-87

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLT SPOON DRIVEN USING A  
MORR HAMMER FALLING 30 in

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 lb HAMMER FALLING 24 in

CASING SIZE:                      OTHER: 3 3/4" R.E.A.

GROUNDWATER READINGS				
DATE	TIME	WATER	TEMP	STABILIZATION TIME
6-11-87	2:00	3.7'	5.0'	drilling
6-11-87	2:10	6.9'	10.0'	drilling
6-12-87	7:00	10'	20'	0.5 days

DEPTH (ft)	CASING (in)	SAMPLE			SAMPLE DESCRIPTION Burrhead (USCS) CLASSIFICATION	STRATUM DESCRIPTION
		No.	DATE	DEPT (ft)		
0		C-1	12/10	0-1.0	Concrete core	1. CONCRETE
		S-1	24/16	1.0-3.0	6-13-18-17 Dense, yellow-brown, coarse to fine SAND, some(-) Gravel, trace(+) Silt changing at 2 feet to brown-gray, medium to fine SAND, trace(+) Silt (6H-SH to 6P-SH)	2. 0.8'± GRAVELLY SAND
		S-2	24/12	3.0-5.0	11-17-23-38 Dense, brown-gray, medium to fine SAND, trace(+) Silt (6P-SH)	3. SANDY FILL
5		S-3	24/18	5.0-7.0	4-6-7-7 Medium dense, Gray, medium to fine SAND, trace(+) Silt (slight organic odor) (SP-SH)	4. 5.0'± SAND
10		S-4	24/14	10.0-12.0	1-1-1-3 Very loose, dark gray, organic SILT, trace fine Sand, (organic odor) (OH)	5. 8.5'± ORGANIC SILT WITH SAND LENSES
		S-5	24/9	12.0-14.0	5-5-5-4 Loose, dark gray, coarse to fine SAND, little Gravel, little Silt (organic odor) (SM)	
15		S-6	24/16	14.0-16.0	5-10-R-R Medium dense, dark gray, organic SILT, little fine Sand, trace organic fibers with a 6-inch lens of coarse to fine SAND, little Silt (OH)	

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V LOOSE	4-8	V SOFT
4-10	LOOSE	8-15	SOFT
10-30	M DENSE	15-30	M STIFF
30-50	DENSE	50-100	V STIFF
>50	V DENSE	>100	HARD

#### REMARKS

1. Bit weight 100 lbs (12), time/cure 5-10 min. C-1: 7 5/8" 1.0 (1) (inside diameter).
2. Water used to aid in drilling core.
3. Duplicate sampler taken when available.
4. Broken gravel observed in sample.



NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.  
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING No. B-4

**BORING NO. B-4**



GOLDBERG ZOINO & ASSOCIATES, INC.  
140 BROADWAY, PROVIDENCE, RHODE ISLAND  
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT  
Air National Guard  
Quonset Point, R.I.

REPORT OF BORING No. B-1  
SHEET 1 OF 1  
FILE No. Y-30033  
CHKD BY: AR

BORING Co. Guild Drilling Co.  
FOREMAN Mike McDonald/Darryl Greer  
GZA ENGINEER Steve Simpson

BORING LOCATION See Exploration Location Plan  
GROUND SURFACE ELEVATION  
DATE START 6-6-81 DATE END 6-6-81

SAMPLER UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" I.D. SPOON DRIVEN USING A  
MOB. HAMMER FALLING 30 IN.  
CASING UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB HAMMER FALLING 24 IN.

GROUNDWATER READINGS				
DATE	TIME	WATER	DEPTH	STABILIZATION TIME
6-9-87	8:45	6.5'	10	Drilling
6-9-87	9:15	6.7'	15	Drilling

CASING SIZE: OTHER: 2 1/4" N.E.A.

DEPTH (ft)	CASING (in/ft)	SAMPLE			SAMPLE DESCRIPTION Burmester (USCS) CLASSIFICATION	STRATUM DESCRIPTION
		No.	PER IN REC	DEPTH (ft)	BLOWS/ft	
0		C-1A	2/8.5	0-1.0		Concrete Core
		S-1	24/12	1.0-3.0	5-16-19-24	Dense, brown-gray, coarse to fine SAND, some(+) Gravel, trace(+) Silt, wood chunk (2" diameter) (SM-SH)
		S-2	24/16	3.0-5.0	22-18-25-23	Dense, brown-gray, medium to fine SAND, trace (+) Silt (SP-SM)
5		S-3	24/12	5.0-7.0	7-5-4-7	Loose, gray, fine SAND, trace(+) Silt changing at 6 feet to black, fine to medium SAND, some silt (SF-SM to SM)
		S-4	24/18	7.0-9.0	10-11-16-27	Medium dense, gray to brown, fine SAND, little Silt; coarse to fine SAND, trace Silt - stratified (organic odor) (SM and SP)
10		S-5	24/18	10.0-12.0	17-23-49-55	Very dense, brown, coarse to fine SAND, trace Silt; coarse to fine SAND, some(+) Gravel, little(-) Silt - stratified (slight organic odor) (SM and SP)
15						Bottom of Boring at 15 feet

GRANULAR SOILS		COHESIVE SOILS	
B.O.S./ft	DENSITY	BLOWS/ft	DENSITY
0-4	V LOOSE	4-2	V SOFT
4-10	LOOSE	2-4	SOFT
10-30	M DENSE	4-8	M STIFF
30-50	DENSE	8-15	STIFF
50+	V DENSE	15-30	V STIFF
		>30	HARD

- REMARKS
1. Bit weight 100 lbs (1), time/cure 5-10 min(1), C-1A 2/3" I.D. (inside diameter), C-1A 8" I.D.
  2. Water used to core concrete.
  3. Duplicate samples taken when available.
  4. Soil blowing into auger. At 11' sampling attempt - end hole at 11'
  5. Borehole filled with soil and surface grouted.

**GZA** NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SIX TYPES TRANSITIONS MAY BE GRADUAL.  
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOG. FLUCTUATION IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING No. B-1

**BORING NO. B-5**

<b>GOLDBERG ZOINO &amp; ASSOCIATES, INC.</b> 140 BROADWAY, PROVIDENCE, RHODE ISLAND GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS		<b>PROJECT</b> Air National Guard Quonset Point, R.I.		<b>REPORT OF BORING NO. B-1</b> SHEET 1 OF 1 FILE NO. Y-30033 CHKD BY. ARU																																	
BORING Co. <u>Guild Drilling Co.</u> FOREMAN <u>Mike McDonald</u> GZA ENGINEER <u>Steve Simpson</u>		BORING LOCATION <u>See Elevation Location Plan</u> GROUND SURFACE ELEVATION <u>        </u> DATUM <u>        </u> DATE START <u>6-9-87</u> DATE END <u>6-10-87</u>																																			
SAMPLER <small>UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A MOB HAMMER FALLING 30 in</small> CASING <small>UNLESS OTHERWISE NOTED, CASING DRIVEN USING 30016 HAMMER FALLING 24 in</small>		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="6">GROUNDWATER READINGS</th> </tr> <tr> <th>DATE</th> <th>TIME</th> <th>WATER</th> <th>TEMP</th> <th>DEPTH</th> <th>STABILIZATION TIME</th> </tr> <tr> <td>6-10-87</td> <td>9:15</td> <td>5.31</td> <td>5'</td> <td></td> <td>drilling</td> </tr> <tr> <td>6-10-87</td> <td>11:00</td> <td>6.61</td> <td>15'</td> <td></td> <td>drilling</td> </tr> </table>				GROUNDWATER READINGS						DATE	TIME	WATER	TEMP	DEPTH	STABILIZATION TIME	6-10-87	9:15	5.31	5'		drilling	6-10-87	11:00	6.61	15'		drilling								
GROUNDWATER READINGS																																					
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CASING SIZE: <u>        </u> OTHER <u>2 1/4" R.S.A.</u>																																					
DEPTH (ft)	CASING (in/ft)	<b>SAMPLE</b> No. PEN (in) REC. DEPTH (ft) BLOWS/ft		<b>SAMPLE DESCRIPTION</b> <small>BURMEISTER (USCS) CLASSIFICATION</small>		<b>STRATUM DESCRIPTION</b>																															
0		C-1A	12/6	0-1.0		Concrete Core	1. 0.5'± CONCRETE																														
		S-1	24/10	1.0-3.0	12-15-19-16	Dense, gray-brown, coarse to fine SAND, some Gravel, trace Silt (SM)	2. 3. 4. GRAVELLY SAND																														
		S-2	24/16	3.0-5.0	15-13-31-40	Dense, gray-brown, medium to fine SAND, trace Silt (SP)	5. 3'±																														
5		S-3	24/14	5.0-7.0	1-2-1-1	Very loose, gray-brown, medium to fine SAND, trace Silt (SP)	SANDY FILL																														
10		S-4	24/16	10.0-12.0	2-5-10-6	Medium dense, gray, coarse to fine SAND, little(-) Gravel, trace(+) Silt, trace(-) organic fibers (slight organic odor) (SP-SM)	8.5'± SANDS and GRAVELLY SANDS																														
15						Bottom of Boring at 15 feet	5. 6.																														
		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="2">GRANULAR SOILS</th> <th colspan="2">COHESIVE SOILS</th> </tr> <tr> <th>BLOWS/FT</th> <th>DENSITY</th> <th>BLOWS/FT</th> <th>DENSITY</th> </tr> <tr> <td>0-4</td> <td>V LOOSE</td> <td>&lt;2</td> <td>V SOFT</td> </tr> <tr> <td>4-10</td> <td>LOOSE</td> <td>2-4</td> <td>SOFT</td> </tr> <tr> <td>10-30</td> <td>M DENSE</td> <td>4-8</td> <td>M STIFF</td> </tr> <tr> <td>30-50</td> <td>DENSE</td> <td>8-15</td> <td>STIFF</td> </tr> <tr> <td>&gt;50</td> <td>V DENSE</td> <td>15-30</td> <td>V STIFF</td> </tr> <tr> <td></td> <td></td> <td>&gt;30</td> <td>HARD</td> </tr> </table>		GRANULAR SOILS		COHESIVE SOILS		BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	0-4	V LOOSE	<2	V SOFT	4-10	LOOSE	2-4	SOFT	10-30	M DENSE	4-8	M STIFF	30-50	DENSE	8-15	STIFF	>50	V DENSE	15-30	V STIFF			>30	HARD	<b>REMARKS</b> 1. Bit weight 100 lbs (1), time/core 5 min (1). C-1A: 2 3/4" I.D. (1). 2. Water used to core through pavement. 3. Duplicate samples obtained when possible. 4. Broken gravel observed in sample. 5. Sand blowing into auger at 15' sampling attempt (3' (1) into auger) - terminate borehole. 6. Hole backfilled with drilled grout and surface cemented.	
GRANULAR SOILS		COHESIVE SOILS																																			
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY																																		
0-4	V LOOSE	<2	V SOFT																																		
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		<b>NOTES</b> 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.																																			

**BORING NO. B-6**

GOLDREICH ZONING & ASSOCIATES INC  
140 BROADWAY PROVIDENCE RHODE ISLAND  
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT

A-1 National Super  
Sewerage System

REPORT OF BORING NO. P-7

SHEET 1 OF 2  
FILE NO. 3-30-77  
CHECK BY: AH

BORING CO. Gold Drilling Co.  
FOREMAN Mike McHugh  
GZA ENGINEER Greg Gardner

BORING LOCATION Per Exploration Location Plan

GROUND SURFACE ELEVATION: DATUM

DATE START 6-12-87 DATE END 6-12-87

SAMPLER UNLESS OTHERWISE NOTED SAMPLER CONSISTS OF A 2" S.P.N. SPOON DRIVEN USING A  
MOR HAMMER FALLING 30"

CASING UNLESS OTHERWISE NOTED CASING DRIVEN USING 300# HAMMER FALLING 24"

GROUNDWATER READINGS

DATE	TIME	WATER	TEMP	STABILIZATION TIME

CASING SIZE OTHER 3 3/4" H.S.A.

DEPTH (ft)	CASING (in)	SAMPLE				SAMPLE DESCRIPTION Burmester (USE) CLASSIFICATION	STRATUM DESCRIPTION
		NO.	PER SEC	DEPTH (ft)	BLOWS/6"		
0		C-1	24/24	0-0.5		Concrete core	1 0-5' CONCRETE
		S-1	24/24	0.5-2.5	6-12-23-25	Dense, brown, fine to coarse SAND, trace Gravel changing at 1 foot to fine SAND, trace Silt (ST)	2 1-2 GRAVELLY SAND
							3
							SAND FILL
		S-2	24/24	2.5-4.5	9-11-17-31	Dense, gray, fine to medium SAND, trace(4) Silt changing at 4 feet to fine SAND with occasional lenses of organic Silt (ST-5M)	4-2
5		S-3	24/24	5.0-7.0	3-7-7	Loose, dark brown, fine SAND and organic matter (fine roots), some(4) organic Silt (ST)	SAND WITH ORGANIC SILT
10		S-4	24/24	10.0-12.0	4-7-11-10	Medium dense, gray, fine to medium SAND, little(-) Silt (ST)	10-2
							STRATIFIED SILTS SAND
15		S-5	24/24	15.0-17.0	4-5-7-11	Medium dense, gray, fine to medium SAND, trace(4) Silt, fine SAND, little Silt stratified (ST-5M and ST)	4
						Bottom of boring at 17 feet	

GRAIN SIZE	SCOLS	COMESIVE	SP. S.
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V LOOSE	4-7	V SOFT
4-10	LOOSE	7-14	SOFT
10-30	M DENSE	14-30	M STIFF
30-50	DENSE	30-50	STIFF
50+	V DENSE	50+	HARD

REMARKS 1. Bit weight 300 lbs (10' sampler core 5-10 min (11' C-1) 2 3/4" (11' 1/8" inside diameter)  
2. Water used to aid in drilling concrete core  
3. Duplicate samples taken when available  
4. Hole backfilled with drilled mud and surface cemented



NOTES 1. THE STRATIFICATION LINE REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. THANK YOU! MAY BE CHANGED.  
2. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON  
THIS BORING LOG. FLUCTUATION IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN  
THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING NO. P-7

BORING NO. B-7

<b>GOLDBERG ZOINO &amp; ASSOCIATES INC</b> 140 BROADWAY, PROVIDENCE, RHODE ISLAND GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS		<b>PROJECT</b> Air National Guard Quonset Point, R.I.	<b>REPORT OF BORING No</b> B-8 <b>SHEET</b> 1 <b>OF</b> 1 <b>FILE No</b> Y-30033 <b>CHKD BY</b> ABV															
<b>BORING Co</b> Guild Drilling Co <b>FOREMAN</b> Mike McDonald <b>GZA ENGINEER</b> Steve Bjornson		<b>BORING LOCATION</b> See Exploration Location Plan <b>GROUND SURFACE ELEVATION</b> _____ <b>DATUM</b> _____ <b>DATE START</b> 6-11-87 <b>DATE END</b> 6-11-87																
<b>SAMPLER</b> UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A MOB HAMMER FALLING 30 IN <b>CASING</b> UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB HAMMER FALLING 24 IN		<b>GROUNDWATER READINGS</b> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>DATE</th> <th>TIME</th> <th>WT</th> <th>COOR</th> <th>STABILIZATION TIME</th> </tr> <tr> <td>6-11-87</td> <td>8:30</td> <td>3.9</td> <td>5.0'</td> <td>Drilling</td> </tr> <tr> <td>6-11-87</td> <td>9:00</td> <td>5.1</td> <td>10.0'</td> <td>Drilling</td> </tr> </table>		DATE	TIME	WT	COOR	STABILIZATION TIME	6-11-87	8:30	3.9	5.0'	Drilling	6-11-87	9:00	5.1	10.0'	Drilling
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6-11-87	8:30	3.9	5.0'	Drilling														
6-11-87	9:00	5.1	10.0'	Drilling														
<b>CASING SIZE</b> OTHER: 3 3/4" A.S.A.																		

DEPTH (ft)	CASING (in/ft)	SAMPLE			SAMPLE DESCRIPTION Burmeister (UECS) CLASSIFICATION	STRATUM DESCRIPTION
		No	IN IN	DEPTH (ft)		
0		C-1	12/8	0-1.0	Concrete Core	1. 0.7'± CONCRETE
		S-1	24/10	1.0-3.0	Dense, gray-brown, medium to fine SAND, trace(+) Silt; coarse to fine SAND, little(-) Silt (SP-SM)	2. SAND and GRAVELLY SAND
		S-2	24/14	3.0-5.0	Dense, brown-gray, coarse to fine SAND, some Gravel, trace(+) Silt changing at 4 feet to medium to fine SAND, trace(+) Silt (SW-SM to SP-SM)	3. SAND and GRAVELLY SAND
5		S-3	24/16	5.0-7.0	Medium dense, gray-brown, medium to fine SAND, trace(+) Silt (SP-SM)	4. SANDY FILL
10		S-4	24/18	10.0-12.0	Loose, gray, medium to fine SAND, little Silt, trace(-) organic fibers; coarse to fine SAND, trace(+) Silt (slight organic odor) (SM; SP-SM)	5. SILTY SAND
15					Bottom of Boring at 12 feet	

<b>GRANULAR SOILS</b> BLOWS/ft DENSITY 0-4 v LOOSE 4-8 m LOOSE 8-16 m DENSE 16-30 v DENSE 30-50 DENSE 50-100 v DENSE	<b>COHESIVE SOILS</b> BLOWS/ft DENSITY 0-2 v VERY 2-4 m VERY 4-8 m STIFF 8-16 m STIFF 16-30 v STIFF 30-50 DENSE 50-100 v DENSE	<b>REMARKS</b> 1 Bit weight 30 lbs - blow rate 5 min/ft. 2 Water used in drilling concrete core 3 Concrete core broke apart in core sampler apparently due to its low strength 4 Broken gravel observed in sample. 5. Installed well: Filter sand 10'-9.5' (sl. 1 1/2" slotted PVC @ 1/2" 2 1/2' (sl), filter 2 1/2" - ground surface (sl). Filter sand in annular space 9 1/2'-2' bentonite seal 2'-1'. Install and grout roadway
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	<b>NOTES</b> 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES TRANSITIONS MAY BE GRADUAL 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT THESE AND LOWER DEPTHS AS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE
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**BORING No** B-8

BORING NO. B-8

**BORING NO. B-9**

<b>GOLDBERG-ZOINO &amp; ASSOCIATES, INC</b> 140 BROADWAY, PROVIDENCE, RHODE ISLAND GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS		<b>PROJECT</b> Air National Guard Quonset Point, R.I.	<b>REPORT OF BORING No</b> B-10 <b>SHEET</b> 1 <b>OF</b> 1 <b>FILE No</b> Y-30033 <b>CHKD BY</b> ABH																									
<b>BORING Co</b> Guild Drilling Co. <b>FOREMAN</b> Mike McDonald <b>GZA ENGINEER</b> Steve Simpson		<b>BORING LOCATION</b> See Exploration Location Plan <b>GROUND SURFACE ELEVATION</b> _____ <b>DATUM</b> _____ <b>DATE START</b> 6-9-87 <b>DATE END</b> 6-9-87																										
<b>SAMPLER</b> UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A MOB HAMMER FALLING 30 in <b>CASING:</b> UNLESS OTHERWISE NOTED, CASING DRIVEN USING 3001B HAMMER FALLING 24 in		<b>GROUNDWATER READINGS</b> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>DATE</th> <th>TIME</th> <th>WPT</th> <th>DOWN AT</th> <th>STABILIZATION TIME</th> </tr> <tr> <td>6-9-87</td> <td>12:35</td> <td>4.0'</td> <td>5.0'</td> <td>drilling</td> </tr> <tr> <td>6-9-87</td> <td>1:05</td> <td>6.0'</td> <td>10.0'</td> <td>drilling</td> </tr> <tr> <td>6-10-87</td> <td>7:30</td> <td>3.6'</td> <td>---</td> <td>18 hrs. (s) ***</td> </tr> <tr> <td>6-11-87</td> <td>8:00</td> <td>3.6'</td> <td>---</td> <td>42 hrs. (s)</td> </tr> </table>		DATE	TIME	WPT	DOWN AT	STABILIZATION TIME	6-9-87	12:35	4.0'	5.0'	drilling	6-9-87	1:05	6.0'	10.0'	drilling	6-10-87	7:30	3.6'	---	18 hrs. (s) ***	6-11-87	8:00	3.6'	---	42 hrs. (s)
DATE	TIME	WPT	DOWN AT	STABILIZATION TIME																								
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6-11-87	8:00	3.6'	---	42 hrs. (s)																								
<b>CASING SIZE:</b> _____ <b>OTHER:</b> 3 3/4" H.S.A.																												

DEPTH (ft)	CASING (in/ft)	SAMPLE		SAMPLE DESCRIPTION	STRATON DESCRIPTION	
		No	DEPTH (ft)			
0		C-1	12/8	0.0-1.0	Concrete Core	
		S-1	24/12	1.0-3.0	7-12-17-19	Medium dense, yellow-brown, fine to coarse SAND, some (-) Gravel, trace Silt changing at 1.5 feet to fine to medium SAND, little Silt (SM to SM)
		S-2	24/14	3.0-5.0	10-12-12-10	Medium dense, brown-gray, fine to coarse SAND, trace Gravel, trace Silt (SF)
5		S-3	24/12	5.0-7.0	3-4-3-2	Medium dense, brown-gray, fine to coarse SAND, trace Gravel, trace Silt changing at 6 feet to fine SAND, little Silt - (slight organic odor) (SP to SM)
10		S-4	24/18	10.0-12.0	4-12-11-11	Medium dense, gray, medium to fine SAND, little Silt (slight organic odor) (SM)
15					Bottom of Boring at 12 feet	
					*** NOTE: Bottom 2'(s) of well silted in.	

GRANULAR SOILS		COHESIVE SOILS		REMARKS
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY	
0-4	V LOOSE	<2	V SOFT	1. Coring time 5-10 min. Bit weight approximately 100 lbs & diameter of core = 1 1/2". 2. Water wash used during coring. 3. Duplicate samples taken when available. 4. 1 1/2" PVC slotted well pipe installed 10' to 5' below ground-surface, riser 5'-0" below ground-surface. Filter sand placed in annular space from 10'-3'. Bentonite seal from 3' to 2'. One roadbox installed, grouted in place.
4-10	LOOSE	2-4	SOFT	
10-30	M DENSE	4-8	M STIFF	
		8-15	STIFF	
30-50	DENSE	15-30	V STIFF	
>50	V DENSE	>30	HARD	

**NOTES**

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.

2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

**BORING No** B-10

## BORING NO. B-10